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CLASSIFICATION OF THE BANANAS

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III. Critical Notes on Species*.

m. **Musa fehi** *Bert.* ex Vieill. in Ann. Sci. Nat. Sér. 4, **16,** 45 (1862).

M. fehi is generally understood to mean a wild or semi-domesticated *Musa* occurring in several Pacific islands, distinguished by an erect inflorescence and violet sap, and having both parthenocarpic and fully fertile forms. Dodds (Nature **157,** 729–30 : 1946) has shown that one form answering to this general description has 10 pairs of chromosomes, and evidently belongs to a group of species not very closely related to the bananas and plantains commonly cultivated throughout the Tropics.

This group of species, as a group, has only recently been recognised ; but there is a good deal of fragmentary evidence in the literature to show that it is a rather large one, with members in several parts of Australasia. Our knowledge of the group, and of *Musa* in general, in that part of the world is so very small that it is impossible even to hazard an opinion about the number of forms that may possibly be included under *M. fehi sensu lato.* It may, however, be convenient to botanists working on the group to have brought together in one place some of the scattered observations that concern the taxonomy and nomenclature of the species.

For the sake of clarity it seems best to assume that at least three different plants have been confused under the name *M. fehi.* The three can then be discussed separately without prejudice to the question whether they are conspecific, and researches to determine the latter point may be facilitated.

Musa fehi sensu stricto is a plant of New Caledonia described by E. Vieillard in an article entitled " Plantes utiles de la Nouvelle-Calédonie " which appeared in *Annales des Sciences Naturelles,* 4th Series, Botanique, Tome 16 (1862) pp. 28–76. Its description may be translated from the French as follows :

" Musa fehi Bert. Dáak of the natives.

*Continued from Kew Bull. **1949,** 272 (1949).

Trunk robust, 5 to 6 metres high, greenish in colour with violet streaks, filled with an abundant sap of a beautiful violet ; blade of the leaves very broad, strongly nerved. Inflorescence in one long terminal spadix *erect* ; flowers sub-sessile, 6–8 in the axil of the spathes, erect and without bracts (dépourvues de bractées) ; perianth bilabiate ; upper lip tubular, striate, divided posteriorly to the base, subcalcarate, with five unequal lobes, terminated by acute bristles ; lower lip short, concave, striate, subdiaphanous ; stamens 5, three times shorter than the style which is thick and compressed ; stigma clavate, funnel-shaped, with six short lobes ; berries oblong, angular, straight, with thick pericarp, yellow at maturity ; pulp mediocre raw, but excellent cooked ; sometimes the seeds attain full development and are able to germinate.

The violet sap that one gets by cutting the stalks serves as a blue dye.

Musa fehi is little cultivated ; it grow spontaneously in the mountains ; it multiplies itself by suckers and by seeds".

Such is the type, and after investigation in New Caledonia to ensure that only one local form meets the description, living material from that island should be the standard against which other " fehis " are to be compared.

The second plant to be considered grows in Tahiti, and was mentioned by J. Nadeaud in his " Enumération des plantes indigènes de l'ile de Tahiti " published in Paris in 1873. His account, also French, occurs on p. 39 and may be translated :

" Musa fei (Bertero MSS) *Fei* of the natives.

This species is truly indigenous. Towards the month of December the fruits contain perfectly developed seeds which are capable of germination. These are the seeds that the Tahitians call by the name " iriiri ", little stones. They are so frequent at this time of year, that the natives looking for fruit-bunches are obliged to sacrifice a large number before finding one that does not contain these seeds (which are) hard and disagreeable on the teeth. However, all the feis that I ate on the 12th July 1857 on the shores of Lake Vaihiria were abundantly provided with them".

It will be noted that there is nothing to identify this plant with Vieillard's except the use of the same name, slightly differently spelt, from a manuscript by Bertero. I have not been able to discover exactly how or where Bertero applied the name attributed to him, but comparison of vernacular names suggests that in the manuscript it was attached to a Tahitian plant. However, since Vieillard published it first, the name *M. fehi* must now apply primarily to a species of New Caledonia. If the Tahitian plant should prove to be distinct there is an alternative combination available for it in *Musa aiori* Sagot.

The French botanist P. Sagot became interested in the variable seediness of the Tahitian " fehi " and published a note on it in 1886 (*Bull. Soc. Bot. France* **33** : 317–326). He had asked Monsieur E. Cotteau to make observations for him in Tahiti, and reports the result. M. Cotteau had enquired for seeds, and been informed that the fruits collected by the natives and sold in the town never contained any. Only one old native woman assured him that seeds were found sometimes, and he had great

difficulty in finding any. In a large number of fruits he only came across one or two, which were useless for sowing because the fruits had been cooked before the seeds were found. Leaving the island M. Cotteau left certain instructions ; as a result of which, more than a year later, seeds were received in Paris. They proved to be imperfect seeds : Sagot showed them to Vieillard, who agreed in that particular and said that he himself had seen similar ones in Tahiti, but had not seen perfect ones, nor fruit containing any, nor plants bearing them, though he had heard about them from natives. Sagot also remarked in this note that " Dr. Vieillard has found Musa fehi wild in the north of New Caledonia, where it is rare—its fruits contained no seeds ". This remark suggests that the original description of *M. fehi* was based partly on hearsay.

In Sagot's posthumous " Manuel pratique des Cultures Tropicales et des Plantations des pays chauds " edited by E. Raoul and published in Paris in 1893, the Tahitian " fehi " appears as : *Musa fehi* Bert. *Musa aiori* Ipse *M. troglodytarum* L. *M. uranoscopus* Rumph. Aïori of the Tahitians. Following a description, Sagot repeats the substance of his note of 1886 and there follows a very interesting note by Raoul which may be translated :

" Overtaken by death, my excellent friend Dr. Sagot had not had time to revise the few preceding lines on information that I had given him. I have left them untouched and give the information here. It is not exactly true that fehis very rarely contain seeds. It is necessary to distinguish : the varieties of fehis known up to the publication of this work give fruits *always* without seeds. One kind alone, designated by the name of Aiori (little stones) is *always* provided with seeds at the time of ripening.

This kind which is the true fehi is doubtless the origin of all the seedless varieties that one meets with in Oceania."

Raoul adds the native names of 10 other " espèces, races et variétés de féhis de la Polynésie " indicating a polymorphic assemblage to be studied.

It may be noted here that the observations of K. S. Dodds cited above fully bear out Raoul's note and clear up the confusion that has since arisen through the quotation of Sagot's opinions without this correction.

The third plant to be considered occurs in Fiji and was first mentioned by Berthold Seemann in his " Flora Vitiensis " published in London, 1865–73. He called it *Musa uranoscopus* and gave it (p. 290) this description :

" M. uranoscopus, Rumph. Amb. vol. V. p. 137. t. 61. f. 2 ; foliis angustatis ; spadice erecto, apice demum fl. deciduis denudato incurvo ; baccis obovoideo-ellipsoideis, parvis (rufis v. aurantiacis)—*M. Troglodytarum*, Linn. Spec. n. 1478. Nomen vernac. Vitiense, " Soaqa " ; Samoense, " Soa'a " ;—In woods of Viti Levu and Taviuni ; occasionally cultivated (Seemann ! n. 619)."

The name *M. uranoscopus* Rumph. will have to be discussed below, but the plant to which it refers was doubtfully the same as Seemann's. Baron Ferdinand von Mueller was of that opinion and in 1875 in notes following the description of *M. fitzalani* (*Fragmenta Phytographiae Australiae* **9**, 190, 1875) he suggested the name *M. seemannii* for the Fiji plant.

Later, in the course of an article on various plants of New Guinea (Proc. Linn. Soc. New South Wales **10,** 355 : 1885) von Mueller returned to the species :

" This seems an apt opportunity for referring to an allied species : Musa Seemannii of Fiji, from whence it was first recorded by Dr. Seemann as M. uranoscopus (Fl. Vit. 290). Specimens kindly transmitted by the Hon. J. B. Thurston C.M.G. enable me to offer the following notes on the Fiji plant. Flower stalk erect, about 4 ft. long, and to four inches thick ; the bracts imbricate, the longest measuring fully one foot ; total fruit spike about 1 1/2 feet long, forming fascicles moderately crowded on all sides ; fruits ellipsoid-ovate, remarkably blunt, 3 to 4 inches long, when aged blackish-brown outside and shining, with three of the longitudinal angles more prominent ; pulp very succulent, of not unpleasant taste, from brown-yellow to vitellinous in colour ; pericarp thinly coriaceous ; ovules numerous, turbinate-discoid, reaching in the ripe fruit not to beyond one lines length, outside blackish-grey ".

Such, then, are the three described entities that commonly go under the name of *M. fehi.* It seems very probable that they are conspecific, but the fact is that nobody has compared them critically nor adequately distinguished them from fully seeded forms of similar affinity but different habit that occur in the same area. J. G. Baker in his " Synopsis of the Genera and Species of Museae " (*Ann. Bot.* **7,** 218 : 1893) was cautious about the identification. He gives *M. fei* Nadeaud as a synonym of *M. fehi* Bert. ex Vieill., but his mention of the Fiji plant occurs after the description, thus :

" Probably the Fijian *M. Seemanni*, F. Muell. Fragm. IX, 190 (name only), of which a photograph, sent by Sir John Thurston, is reproduced Gard. Chron. 1890, II, 162, fig. 28, is the same species. This is *M. Uranoscopos*, Seem. Fl. Vit. 290, and M. Troglodytarum, Kurz, in Journ. Agric.–Hort. Soc. Ind. N.S. V, 163, in part ".

Later authors have been less careful, and with this species as with others, everything that Baker mentioned has gone into the synonymy without question.

When the taxonomic points are cleared up there will remain a nomenclatural problem which involves a fourth entity. This is a plant described and figured by Rumphius in *Herbarium Amboinense* **5,** 125. t. 61. fig. 2 (1750) as *Musa uranoscopus* and re-named by Linnaeus in the second edition of *Species Plantarum*, 1478 (1763) *M. troglodytarum.* Linnaeus's species is directly based on that of Rumphius ; no doubt arises about the identity of the two, and therefore the Linnaean name is valid and must be used. The question is the identity of the plant. It will have been noted from the extracts given above that both Sagot and Seemann thought it was the same as the species they were dealing with, but von Mueller was doubtful. Kurz (Journ. Agric.–Hort. Soc. India N.S. V. 163) in 1878 seems to have been of the same opinion as Seemann, and his contribution is worth quoting. It runs :

" Musa Troglodytarum, L. This species is as yet but imperfectly known, although it is one of the most cultivated forms of Australasia, extending as far west as the Moluccas and the Phillipines. It is a very distinct species in habit, much resembling M. textilis and as large. The

erect spadix, and much imbricated green bracts alone distinguish this from the rest of the cultivated species. The only figure of this is the one given by Rumph in his Herb. Amb. V t. 61 f. 2.

1. Pisang tongkat langit. Fruits three inches long and 1 1/2 inches thick, tapering to the 3-cornered base, of the colour of a dark-coloured carrot or rather brown-red ; the pulp is golden yellow, like gamboge, soapy, of a tolerably sweetish taste, but rather mawkish. There are usually 7–8 fruit whorls to the spadix (Binnendyke MS)."

Kurz appears to have been describing the plant from personal observation as he adds characters not given by Rumphius, and it would be very useful to know how much was observation and how much inference. He uses the same vernacular name as Rumphius. A difference is that Rumphius mentions smooth brown seeds, but he also implies that the fruit was sufficiently pulpy to be edible when cooked, and describes the flavour as " viscous and acidulous but when ripe sweet enough ".

The Rumphian type was, according to its author, of rare occurrence, grown in gardens as a curiosity on account of its rarity, especially in the Moluccas, rare in Amboina. He adds that it is found in northern Ceram. What is required, therefore, is a plant from northern Ceram which fits Rumphius's description and can be compared with authentic *Musa fehi*. It must have an erect inflorescence, long and relatively narrow bud, green glabrous bracts, small thick rounded fruits ripening red, and smooth brown seeds. If found, this plant will almost certainly prove to be closely related to *M. fehi* even if it is a distinct species. But until it is found, and grown with *M. fehi* for comparison, there is no advantage to be gained by changing the better-known name of the latter species to *M. troglodytarum* on conjecture.

In conclusion, reference must be made to some other " troglodytara " and " uranoscopi " that may confuse the student :

Musa uranoscopos of Joannus de Loureiro, in his *Flora Cochinchinensis* (p. 645) of 1790 is quite obviously an entirely different plant, although Loureiro cites Rumphius and *Musa troglodytarum* L. It has a " stem " 4 feet high and an inch thick, and linear red bracts each subtending about two flowers. This has been regarded with some reason as identical with *Musa coccinea* Andrews : it certainly has nothing to do with *M. fehi*.

Musa uranoscopus Colla, *Mem. Gen. Musa* 59 (1820) is the same as the plant of Rumphius. Colla changed back the name because he rightly thought it more appropriate than the Linnaean epithet, but by the rules of nomenclature his combination is invalid and must be discarded.

Musa troglodytarum of Blanco in *Flora de Filipinas* (1837) is a composite name covering three or four quite distinct species, none of which appears to be *M. fehi*, and the name and descriptions can be neglected in this connexion.

CLASSIFICATION OF THE BANANAS.

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III. Critical Notes on Species.

n. **Musa peekelii** *Lauterbach* in Engler's Jahrb. **50,** 306 (1913).

The original diagnosis by Lauterbach runs as follows :

Planta permagna, habitu *M. paradisiacae* L., an stolonifera?; petiolo non viso ; folia oblonga, densissime venosa, margine longitudinaliter striata ; inflorescentia nutans, bracteis lanceolatis subacutis, basi modice angustatis ; flores biseriales sessiles, perigonium striatum, 5-lobum, lobis 3 majoribus triangularibus, longe et tortuose corniculatis, 2 oblongis, tepalum liberum oblongum, basi subacutum, apice apiculatum ; antherae lineares, subacutae ; stylus filiformis stigmate subcapitato ; fructus baccatus oblongus, statu juvenili trigonus, deinde subrotundus, basi angustatus, apice productus truncatus, vix carnosus ; semina permulta, oblique angulata, brunnea, radialiter subsulcata, margine minute erosa.

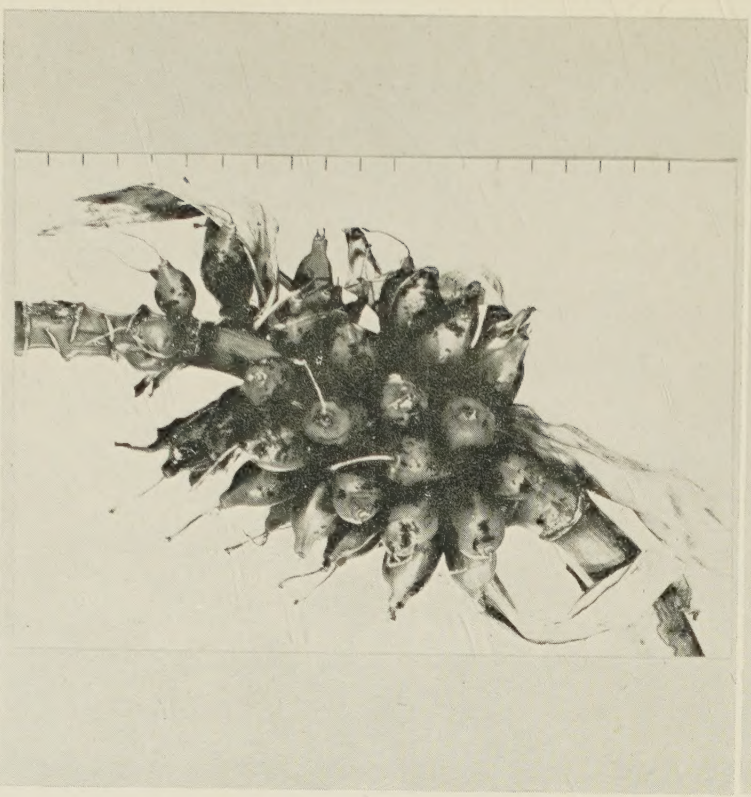
From the accompanying German notes we get the dimensions : Plant up to 10 m. high ; leaves 30 cm. wide ; inflorescence 1–2 m. long ; bracts 17 cm. long, 3–4 cm. wide ; flowers 6 cm. long, 3 lobes of the compound tepal 2–3 mm. long, 2 smaller, free tepal 3 cm. long 11 mm. wide ; filaments 2 cm., anthers 2–2·5 cm. long ; style 4·5 cm. ; fruit 9 cm. long by 3 cm. in diameter ; seeds 7 mm. long, 4 mm. wide.

The description is based on *Peekel* 390, collected in the Bismarck Archipelago on Neu-Mecklenburg (i.e. New Ireland) at Lahur by Namatanai, on red loam, 9 March 1910. Lauterbach adds that if the plant has stolons it should belong to the subgenus *Eumusa* and stand near *M. textilis* Née, otherwise it seems to be related to *M. fitzalani* F.v.M. of Queensland. Accepting his opinion of its relationship, I place the species in my section *Australimusa*.

The description has been given in full in order to draw attention to some difficulties in its interpretation. It was evidently compiled from dried fragments with scanty field notes, as there is no mention of characters such as the colour of the bracts or the shape of the male bud which would be useful in determination of living material.

We received in August 1939 (Introduction No. 229) seeds collected at Rebehen village in Namatanai, sub-district of New Ireland, which were sent to us by Mr. G. H. Murray, Director of Agriculture, Rabaul, as *M. peekelii*. Plants raised from these seeds have flowered in Trinidad and have been compared with Lauterbach's description and figures.

The agreement is on the whole close, and such discrepancies as there are may reasonably be ascribed to the imperfections of the type material. The most serious of them is in the male bud, which in our plant has the bracts very strongly imbricated but in Lauterbach's figure is shown with the bracts scarcely imbricated at all. The figure may, however, reasonably be taken as an artist's effort to reconstruct the whole inflorescence from fragments, and perhaps from a rough sketch ; it brings out well other characteristics of the species such as the persistence of the reflexed bracts after the fall of the male flowers, and indubitably shows a plant at



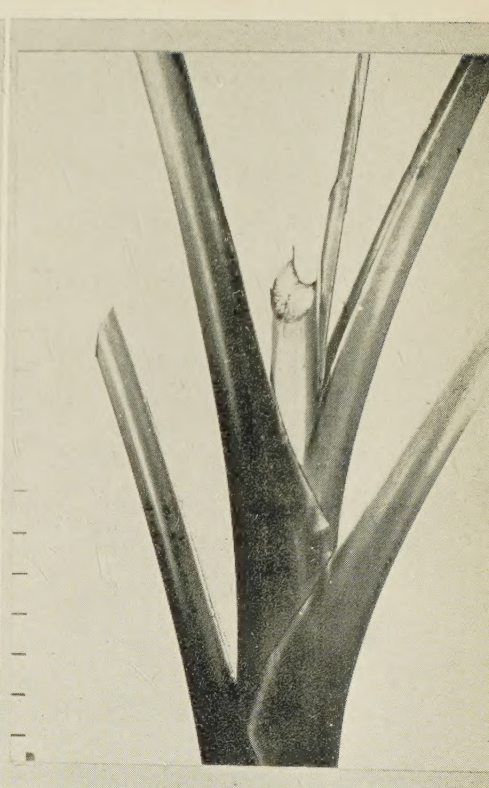


PLATE 1

M. peekelii Lauterbach

Fig. 1. Male bud in advanced blooming, showing persistence of bracts.

Fig. 2. Fruit bunch approaching maturity.

Fig. 3. Upper end of pseudostem, showing petiole margins.

Scales in inches.

Photographs by K. S. Dodds.

least very closely related to ours, but its proportions are not convincingly lifelike for any species of this affinity.

Other discrepancies are easily explicable. Difference in plant size will depend partly on growth conditions and partly on the fact that our figure is measured pseudostem height, whilst Lauterbach's is estimated overall height. The leaf width given is clearly that of the upper part of an upper leaf : any *Musa* 10 m. high having leaves only 30 cm. wide would present a strikingly unusual appearance in the field which would be sure to attract the collector's attention and appear in the notes. The bract width is probably underestimated through shrinkage on drying. It seems significant that the dimensions least subject to these common errors in *Musa*—those of the flowers, fruit and seed agree almost exactly in Lauterbach's description and in mine, written before seeing his. Furthermore the radial wrinkling of the seed, described by both of us independently, seems to strengthen the probability of identity.

I therefore accept our No. 229 as correctly named, and offer as a contribution to our knowledge of *M. peekelii* the following description of living material :

Plant stooling freely ; pseudostems up to 5 metres high 25–30 cm. in diameter at base, bright green, shiny, devoid of wax, developing brown markings in age, but not heavily. Leaf blades up to 3 m. long, 60 cm. wide, narrowed towards the apex, finally narrowly truncate, rounded at base, one side a little longer than the other, dark green above, paler and moderately waxy beneath ; midribs green like the lamina above, pale yellowish green below ; petioles 60 cm. long, with narrow erect margins, closely appressed to pseudostem at base, not becoming scarious.

Inflorescence pendulous, its peduncle and rachis glabrous ; sterile bracts about 4, bright green without, yellowish green within, the first about 60 cm. long, the last 35 cm., all rather narrow and very acute ; basal flowers female, the number of female " hands " varying up to 8 or more, upper flowers male.

Female flowers 7–12 per bract, in two rows ; ovary 5 cm. long, at first pale green, soon darkening, glabrous ; compound tepal 5·5 cm. long, whitish at base, upper part and lobes pale orange yellow, solid along the back with 2 substantial keels, hyaline at the margins, its 3 main lobes ovate, 5 mm. long, all provided with a filiform dorsal appendage 3 mm. long, the accessory teeth small ; free tepal ovate, 4 cm. long, 2 cm. wide, white, entire, acute, yellow at extreme tip, scarcely corrugate behind the tip ; staminodes varying in length, the longest about 2·5 cm. ; style 5 cm. including the stigma.

Male bud in advanced blooming rather narrow (about 3 times as long as its diameter) the bracts strongly imbricate (lowermost about 2/3 the length of the bud) ; bracts shining dark green outside, yellow within, rounded at apex, firm in texture, reflexed after flowering and persistent in a withered condition.

Male flowers 12–14 per bract in two rows, 6·5 cm. long overall ; compound tepal 5·5 cm. long, 1·3 cm. wide, cream, its lobes yellow, 5 mm. long, broad and obtuse with hyaline margins, the 2 lateral ones with dorsal appendages 3 mm. long ; free tepal 3–3·5 cm. long, white, truncate at apex with a minute apicula ; stamens finally slightly exserted.

Fruit bunch of about 8 " hands ", ripening reddish orange, with withered bracts persistent among the fruits. Individual fruit 9–10 cm. long, including a pedicel of about 1 cm. and an acumen nearly 1 cm., 3·5 cm. in diameter at centre, only obscurely angled at maturity, but with 3 angles more prominent than the others ; epicarp tending to crack at maturity and developing brown blotches before ripening. Seeds brown, irregularly and sharply angular, wrinkled, the wrinkles radiating from the umbo and hilum, dorsiventrally compressed, 8 mm. across and 4 mm. high.

M. peekelii has 10 pairs of chromosomes (K. S. Dodds, unpubl.) and is of special interest because it extends our knowledge of the little-known section *Australimusa*. Its affinities with *M. textilis* Née are obvious in the field, though it is a very distinct plant and has not (so far as our material is concerned) a useful fibre.

Garden Weeds and their Control*:—Most books on gardening deal to some extent with this subject and numerous papers and articles have been written upon its various aspects. Many will welcome this book, however, for it provides up-to-date information for both the amateur and the professional gardener and sells at a very reasonable price. It is eminently readable, and as both common and scientific names are used throughout it should be welcomed by the man who " potters around the garden " as much as by the more scientifically minded. The latter will no doubt appreciate the lists of references which appear at the conclusion of each chapter.

The author commences with a chapter on the " Whys and Wherefores " of weeds—their dispersal and reproduction ; their value as indicators of soil conditions and as compost for enriching the soil. The danger of their harbouring noxious insects and parasitic fungi is mentioned, in addition to their more obvious undesirability as competitors with cultivated plants. He then discusses, in succeeding chapters, weed control by cultivation and by mechanical, biological and chemical methods. Plumbers' blow-lamps are suggested as small scale alternatives to the commercial flame guns which have not as yet been fully exploited in this country for the destruction of weeds on paths, hard tennis courts and the like.

Chemical weed killers are divided into two groups : (1) Contact weed killers ; (2) Translocated weed killers. Each group is sub-divided into (a) non-selective ; and (b) selective. The " hormone weed killers " are fully dealt with and three tables of chemicals are included which should prove useful for reference purposes. The control of weeds amongst growing plants and in lawns are subjects which are dealt with individually ; also the control of water weeds. The last chapter is devoted to special problems, such as the removal of trees and the eradication of extremely persistent pests such as " Chickweed ", " Bindweed ", " Coltsfoot ", " Couch-grass " and others.

S. G. HARRISON.

*By Stanley B. Whitehead, D.Sc. Publ. by J. M. Dent & Sons Ltd., 1949, pp. 155, price 7/6d. net.

TAXONOMY IN THE SEED-BEARING PLANTS.*

W. B. Turrill.

The seed-bearing plants, or Spermatophyta, form the main mass of vegetation now growing on the surface of the earth Included in the group are all the more important species of direct use to man as sources of food, timber, or raw materials for industry. It is, therefore, to be expected that the classification of the Spermatophyta is of very great importance to all engaged in the study of plants whether from the scientific or economic standpoints. Exact figures of the number of species, genera, and families known to exist, recognized by taxonomists, or estimated to be extant, cannot be given but the following tabulation gives a rough summary of the present size and the rate of growth of the problem we face :

	World Flora.	
To time of Ray (1627–1705)		18,600 all plants
Linnaeus (1753) described and named as species		
	Phanerogams ...	5,322
	Cryptogams ...	617
De Candolle (1813) :		
	Phanerogams ...	30,000 species
Now :	Spermatophyta	250,000 species
	British Flora.	
	Spermatophyta :	1,500 species (excluding aliens and microspecies).

The number of possible classifications is indefinite. Special classifications, constructed by using one or a few selected kinds of characters are often of considerable interest and importance. One recalls Raunkiaer's classification of life-forms. Taxonomy, however, in the usual modern sense of the term, aims at being a general classification based on the associated occurrence of as many characters as possible, with the object of serving a maximum number of purposes in the best possible manner. It is unfortunate that the words " natural " and " artificial " have been used in connection with classification. All classification is a sorting into classes. The sorting is done by man into classes delimited by man. To this extent all classification is artificial. Perhaps a classification based on occurrence in defined habitats comes the nearest to being a " natural " classification but such would be regarded as extremely " artificial " by many taxonomists. However, for reasons that are not only historical but largely valid at the present day, gross or external morphology is the most used tool of taxonomy, within the group of the seed-bearing plants. It is my terms of reference to outline to you the present-day orthodox methods and principles we adopt. I regard as of very great importance the application of new data from other disciplines—ecology, genetics, cytology, etc. This statement is made to safeguard against any suggestion that I am a die-hard for taxonomic orthodoxy. I am convinced of the need for gradual progress from what has been termed alpha taxonomy

* The substance of a lecture given for the Linnean Society and Systematics Association for advanced university students, Nov. 1947.

to an ideal omega that shall include all data relevant in any way to taxonomy. That I have to deal very largely with orthodox methods and to leave to specialist colleagues a consideration of the application to taxonomy of more recent developments in the experimental branches of botany will at least enable me to stress the value of what taxonomy, even at its present stage, can offer to specialists in other branches of science in exchange for future help.

Taxonomic research has been long associated with the formation and maintenance of a herbarium or hortus siccus. The earliest known collections of dried plants made for study date from the first half of the sixteenth century, so far as I have traced the subject.

A modern herbarium consists mainly of dried specimens of plants or parts of plants mounted in some way on sheets of paper of a uniform size, or of a limited number of sizes, provided with field data, and stored in suitable cabinets. The great advantages of a herbarium may be briefly summarized as follows :

(1) Actual specimens are preserved indefinitely for future reference and can include those first described.

(2) Series of specimens can be built up for comparative use.

(3) The material is available at any time of the year.

(4) The sheets can be arranged with all the advantages of a loose leaf system—ease of reference, interpolation, and re-arrangement.

(5) Many sheets occupy relatively little space.

(6) Sheets are easily transported.

The more specific functions of herbaria are very varied. In large general herbaria, such as the Kew Herbarium, the aim is to have represented every species or variety of plant that has been described and named and for certain groups or geographical areas to have a sufficient number of specimens to ensure good monographic or floristic research. At the other extreme is the limited herbarium formed for one restricted purpose, for example, as the basis of a vice-county flora or of a monograph of a single genus. There are all grades between such extremes. The important point is that a herbarium should fulfil a definite function or functions and should not become a mere accumulation of museum junk. The rate of increase of large herbaria is very great. At Kew for the 10 years previous to the last war we received an average of 69,400 specimens a year.

The preparation of adequate herbarium specimens needs care and training but is not expensive. Material should be as complete as possible. Plants to the size of the herbarium sheets should be collected entire, including subterranean parts. Larger plants have to be cut to suitable lengths. A double bend is often preferable to a single bend in allowing a better lay out of leaves and other organs. As far as possible leaf, flower, and fruit material should be collected. From trees, shrubs, and large herbs this should be taken from the same individual though this usually means more than one visit. Mature seeds from the same stock should be packeted for cultivation in the garden of the institution to which the material is to be sent as well as for herbarium preservation. Specimens for pressing should be carefully laid out between sheets of drying

paper. Very often it is advisable to place the material in folded flimsy paper and the folders with the material between drying papers. Sufficient material should be dried for a series of duplicates and a collector's number of a serial run placed with every sheet. Full field notes should be entered immediately in a notebook or in the collector's label book. Such notes should include locality, altitude, date, habitat conditions, and other ecological data, colour and odour of flowers and vegetative parts, details of the population, vernacular name, and economic uses. Within about 24 hours, the drying papers should be changed and regular changes continued till the material is dry. Sometimes drying can be hastened by the use of artificial heat though care must be used not to make specimens too brittle and to cause undue discoloration.. When the material is dry it can be packed specimen by specimen between sheets of newspaper or other convenient packing paper and tied up between cardboards for dispatch or short period of storage. The collector's number referring to particulars in the notebook must be on every sheet.

Many plants require special treatment in place of or additional to such normal collecting. Very fleshy plants may be killed by plunging in boiling water. Succulents may have to be sectioned. Water plants may require floating out. Large fruits may have to be placed in boxes. In many species flowers should be put into spirit or formalin mixtures. A good general formula for permanent preservation in liquid is : methylated spirit $5\frac{1}{2}$ parts, formalin $\frac{1}{2}$ part, water 4 parts, to which is added 5 % glycerine. Photographs, as of trees to show general habit, sketches, drawings, and paintings, can add greatly to the value of dried specimens, though, as a rule, such are not of great use unless accompanied by preserved material.

The next stage of treatment of herbarium material is in the herbarium annex. Parcels of specimens received from collectors are opened, acknowledged and fumigated with HCN. They are then counted, entered, and sent to the botanist in charge of a department. Labels are placed with them, they are sorted, and named as far as possible. A list of names against collector's numbers is prepared and sent to the collector. Specimens required for the herbarium are "laid out", mounted, poisoned, and "laid in". Duplicates are sorted, labelled, and in due course dispatched to other selected institutions.

This is ordinary herbarium routine to which there are many refinements and additions. A fruit collection, a seed collection, a spirit collection, and a collection of plant illustrations are correlated with the main collection. A few more technical details must conclude this part of our survey.

At Kew two sizes of mounting paper are used :

(a) $16\frac{1}{2} \times 10\frac{1}{2}$ inches

(b) $21\frac{5}{8} \times 14\frac{1}{2}$ inches

The former is the standard size and takes over 95 per cent. of the material. The latter is used especially for palms and cycads. The usual sticking medium is a mixture of gum and fish glue made up in such proportions as required by the peculiarities of the particular material to be mounted. The gum is made by dissolving 4 lbs. of commercial gum arabic in 2

gallons of water and straining through a fine sieve. For very delicate specimens gum tragacanth is used. Besides, or sometimes in place of, sticking, stems, etc., as necessary, are strapped down with firm paper or linen or sewn down with thread.

Quick and efficient destruction of insects is carried out by fumigation with HCN gas, in a specially constructed gas chamber, with elaborate precautions. We are now experimenting with methyl bromide, gemmaxene, and other modern insecticides. The more permanent poisoning is effected by brushing over the specimens a solution made by dissolving :

16 oz. Calvert's No. 5 Carbolic acid and

16 oz. Corrosive sublimate (hydrarg. perchloride, $HgCl_2$).

in 4 gallons of rectified methylated spirit.

We turn now to the methods of determining specimens in the herbarium. A large collection from a number of geographical areas may have first to be sorted geographically. A collection or part of a collection from one such area is sorted into taxonomic groups, often into families, by a botanist sufficiently familiar with the flora of the area to be able to do this by hand and eye for usually about 90% of the specimens. The specimens of various groups (e.g. *Orchidaceae* and *Gramineae*) are handed over to specialists. In some herbaria the whole of the division of labour is on this taxonomic basis, in others a large proportion of the work is arranged phytogeographically. The botanist has now a smaller or larger number of specimens sorted into families. From past experience he will know the species or at least the genus of very many of them and it only remains to check off his memory by comparison with authentically named, if possible type, material. Others he will have to " work out ". This means a full consideration of all characters shown by the material after careful examination, including dissection under the dissecting, binocular, and compound microscopes. Properly prepared herbarium material can be treated, often by simple boiling in water, so as to reveal a very large range of characters, such as those of floral structure, as well as they can be seen in the living state. All essential characters being known, monographs, floras, and other published literature are used, often with assistance from artificial keys, to determine the specimen approximately. The determination may then be checked by full comparison with authenticated material and the original or some standard description. It may be impossible satisfactorily to determine a specimen in this way and then research begins to find out if the plant represented by the specimen has ever been described and named. All possibly relevant books and papers have to be gone through usually by means of references supplied by the Index Kewensis and its supplements. If the investigator be convinced that he has a " new species "—" new " meaning only one not hitherto described and named—he prepares a Latin description and gives a Latin name that has not been used previously. Even the genus may prove to be new.

Determination of newly received material, including the description of species, genera, etc. new to science, is not, however, the whole or in some ways the most important work of the herbarium taxonomist. As we have seen herbaria tend to increase in size, though we now preach quality

rather than quantity. This increase in numbers is some index to the need for constant taxonomic revision of groups, whether families, genera, species, or phytogeographical groupings. There is continuous addition to our knowledge of plants and this new knowledge has to be incorporated in improved systems of classification. Some groups require more frequent taxonomic revision than others but perhaps one can say that on an average every genus requires a more or less complete revision every 25 years—of course, it does not get it ! How is such a revision carried out ? A preliminary survey is made of the published literature and of the material immediately available. Then one settles down to a detailed examination of specimens. First, one sorts the sheets roughly into previously recognized species and within every such species sorts them geographically at the same time interpreting the data on the labels. Types and other particularly valuable specimens are marked as necessary for special use (and special care). Then one goes back to the beginning and takes every tentatively accepted species one by one. The original description is read and fully considered. The type is fixed and, if available, examined. This may mean visits to or borrowing from other herbaria. Every sheet is then compared with the original description, with type material if possible, and with all other available specimens. A hand-lens, a compound microscope, and a dissecting microscope are used. Copious notes are made and very often drawings, especially of dissections. Borrowed material may be photographed before return—which should not be delayed. If a mongraph is to be published full descriptions are prepared of all species, together with a detailed account of the known range and citation of specimens, and synonyms are listed. Artificial keys are added. The description of a new species is to be based on the type specimen ; the origin of any facts obtained from other material should be clearly indicated. A monographic description includes data obtained from every possible source and every available specimen of the species (or other taxonomic group) as delimited by the monographer. Apart from fixing the name, a type specimen has, for this purpose, no greater value than any other specimen equally well prepared.

Description is obviously an important tool in the hands of the taxonomist. As such it should be properly used. The essentials of an adequate description are accuracy, logical arrangement, absence of vagueness, and sufficient degree of completeness.

Accuracy in taxonomic description means taking infinite pains without being rushed. A logical arrangement is essential for ease of thorough comparison of one description with another. To avoid vagueness there must be a proper use of terms which must always be applied with the same generally accepted or stated definition. It is essential to use measurements wherever possible and the ideal is to give maximum, minimum, mean, mode, and standard deviation. Relative terms should be avoided—thus, " long " and " short " or " broad " and " narrow " mean nothing except against a standard. Colours should be matched with and referred to a colour chart. Ridgway, " Color Standards and Nomenclature " is excellent. Requisite degree of completeness varies from group to group and only experience can determine how much detail should be given.

The following sequence should be followed for descriptions. Some modifications and various additions are necessary in particular groups.

Roots
Stems
Leaves
Inflorescences ; bracts, bracteoles, peduncle, pedicels.
Flowers : calyx, corolla, androecium, gynoecium.
Fruits
Seeds
Seedlings

The general principles for such a scheme are - from below upwards ; from outside inwards. By following these principles there is obtained a high degree of correlation with the order of development in ontogeny.

For leaves, the descriptive sequence should be : simple or compound, outline shape (including lobing), apex, base, length, breadth, margin, texture, upper surface (venation, colour, indumentum), lower surface (venation, colour, indumentum) ; petiole, rhachis, stipules. This sequence should be repeated for leaflets, bracts, bracteoles, sepals, petals, etc., as necessary.

In certain descriptions—as those for species new to science or associated with illustrations—a differential diagnosis, contrasting the species with the one it most resembles, or with more than one affinity, is desirable. Sometimes a short preliminary diagnosis of important characters is useful or the same end may be achieved by having the main diagnostic characters in a different fount (usually italics) from the rest of the description.

In addition to monographs there are floras which may be prepared by one botanist or by several to many under an editor. The functions to be served by a " flora " should determine its scheme of contents. The term is used to cover a multitude of variants from mere lists of names of plants recorded for a given area to elaborate works replete with descriptions, keys, and illustrations. A flora for determination of plants should be either for use primarily in the field or for use indoors—in a laboratory, herbarium, or library. A field flora must be of manageable size and yet contain keys, descriptions, and, preferably, illustrations, sufficient for accurate determination of all the species known to occur in the area. A reference flora should be as complete as possible and therefore may be much too bulky for cartage on collecting trips.

A word must be said about nomenclature. This, in my opinion, should be regarded as a taxonomic tool, not as an end in itself. The practice of quoting the name of the author or authors after the species named is unfortunate and it would be a good thing if it were generally discontinued, except when the full reference to place of publication is given, as it has to be in monographic and some other publications. This would avoid much self advertisement. In general, the International Rules of Botanical Nomenclature are not difficult to follow. They would have been much better had the now discarded " Kew Rule ", of the first published valid name in a given genus been accepted, but it is too late now to refute the Germanic victory. One, therefore accepts the International Rules of 1930 and 1935 and makes the best of them. Whatever be the generalized rules, some difficulties not clearly or adequately covered by them will crop up from time to time and must be

resolved as nearly as possible, often by a process analogous to case law. It may be essential to change names for botanical reasons—such as wrong typification—but to change a long accepted name for nomenclatural reasons only is regrettable. I would appeal to my fellow taxonomists to do this only on the clearest possible evidence and whenever they can to let sleeping dogs lie. Personally I am in favour of the conservation of both generic and specific names on a wholesale scale.

Curatorship, monographic research, and floristic studies occupy most of the time of the professional taxonomist. Such work is not only of fundamental importance, it is also of very great interest to the investigator. In no other department of botany does the student contact so wide a range of problems. The taxonomist alone has the continued opportunity of realizing the wealth of form present in the plant kingdom. In his thoughtful moments, and they are many, he enjoys the beauty of shape, orientation, colour, and harmony of organs whose pattern varies almost indefinitely yet is never grotesque. Often he can relate form to function and still more often suggest to the autecologist or cytogeneticist virgin fields for detailed investigations. When he considers the relationships of species one to another he requires the co-operation of the cytologist and geneticist and in return willingly helps them. It is impossible adequately to undertake research in ecology, cytology, genetics, or any other branch of botany, and, presumably, zoology, without preliminary classification. The same is true also in applied biology—agriculture, horticulture, forestry, and commercial biology.

The connection between taxonomy and horticulture is particularly close. Given the necessary tact and appreciation of one another's points of view there can be the most fertile co-operation between the taxonomist and horticulturist. Moreover, in my opinion, the taxonomist cannot fully know his plants till he has studied them alive, both in the wild and under controlled conditions in an experimental garden. Obviously, in extensive taxonomic work there are limits to the study of living material—hence the very great value of herbaria—but the taxonomist should always seek some reasonable balance between herbarium, field, and experimental studies.

Many taxonomists have linked up their studies with one or both of two subjects about which a few words must be said : plant geography and plant phylogeny.

It has already been emphasized that geographical distribution is of great practical importance to the taxonomist. First, to know where a plant comes from often enables one to use a local flora in its determination. Secondly, and more fundamentally, there is frequently a high correlation between morphological and physiological characters on the one hand and geographical range on the other. Any apparent exceptions demand intensive investigation. The study of geographical distribution is thus essential to the taxonomist and one could support the contention that next to a thorough botanical training a taxonomist requires a training in geography. Naturally, as the taxomomist's knowledge of ranges of species and genera accumulates he tends to consider causes, and to collect yet more facts to throw light on how plants come to have their present distribution. This leads to a specialized yet synthetic study of physiography, meteorology, ecology, geology, palaeontology, and cytogenetics,

added to taxonomy—and the taxonomist then becomes a plant geographer. It is, however, essential to realize that a sound taxonomy is the basis of any and all valid phytogeographical conclusions.

In taxonomy alone of the branches of biology does the research worker have before him evidence as complete as is yet possible of the variety of structure, and sometimes of function, which has been evolved in geological time to produce our existing floras. Again, quite naturally, he contemplates how this has come to be. Accepting the theory of evolution there must be a history of origin and development of any group or class however special or general the classification. Phylogeny can only be deduced with any degree of certainty from a study of relatively complete series of fossils, apart from some exceptions mostly at or about the species level where cytogenetic facts may give very strong or even conclusive evidence. For the Angiosperms palaeobotanical evidence relevant to phylogeny is at present meagre. The syllogism is easy to complete. It is a great pity that so much has been published under the heading phylogeny as if it were fact and not fiction which may or may not give an accurate reflection of the origin and development of a class—a true genesis of the phylum. Anyhow, for the Angiosperms at least, classification must precede and has preceded knowledge of phylogeny. A system based on maximum correlation of characters may well be, up to a point, indicative of, in agreement with, and explained by phylogeny. Please do not misunderstand me. The taxonomist has every methodological right to speculate phylogenetically since such speculation may well suggest new lines of research and also serve to link together otherwise scattered facts. Such desirable speculation, however, succeeds and is not the basis of classification, though, obviously, if it opens up new lines of research it may lead to improvement in the classification.

I was tempted, when preparing this lecture, to break away from my terms of reference and to lay before you the results of a long study of the psychology of taxonomists. I resisted the temptation though you might have found such an account more interesting and much more shocking than what is largely a mass of working details. The satisfactory taxonomist is born not made in the sense that he must have a certain number of innate qualities. He must have a methodical mind with a liking for bringing order out of chaos. He should have a keen aesthetic perception of the beauty of shape, colour, and the relationship of parts. It may sound strange to include qualities usually considered the peculiar right of the artist as necessary to the make-up of the satisfactory taxonomist. Yet, if you consider the taxonomic practices we have discussed, it must become clear that quickened appreciation of curves and other outlines and of balance of organs aids comparison at every stage. There are deeper psychological explanations which some of you will recall. There is no doubt that many taxonomists are born collectors. This may be interpreted as their being endowed with an undue share of the acquisitive instinct. This needs to be kept under control but at least is relatively harmless and may be regarded as a sublimation of such developments of the acquisitive instinct as shown by many historical figures from King Solomon to Hitler. The tremendous symbolic and possessional value ascribed to names—well exemplified in the Old Testament—perhaps explains in part some aberrations of nomenclaturists.

This lecture fits, I hope, into the scheme of the course. I think it very desirable that lectures of a course should not be judged as single isolated events but that it should be realized that the value of the course as a whole is what matters. We are trying to show the value of taxonomy particularly in relation to the rest of biology. Perhaps we may be pardoned for saying we seek for recognition of the importance of the taxonomist when his work is well done and request facilities for expanding and improving that work.

Agriculture in the Sudan.* This book resembles an earlier work prepared by the same editor and publisher in 1940—i.e. *Agriculture in Uganda*. Dr. Tothill (the editor) was at one time Director of Agriculture in Uganda and later in the Sudan, before becoming Director of the Gordon Memorial College. The two books are similar in that the various chapters of which they are composed have been written by acknowledged authorities on those particular subjects in the countries concerned, which is obviously a very desirable procedure in a book devoted to so broad a subject as agriculture.

The book is divided into three parts entitled " General Chapters," " Chapters dealing with Agriculture and Farm Animals " and "Chapters dealing with Province Agriculture ". The first part contains chapters on such subjects as historical background, Egyptian connections, climate, vegetation, geology, soils, land tenure, transport, education and nutrition : while the second part has chapters on crops, weeds, locusts, irrigation, animal husbandry, animal food-stuffs, fertilizers and manures.

In the section on the vegetation of the Sudan a useful summary or general sketch is given in the plant life of this extensive region, which totals nearly a million square miles. The writer (Dr. F. W. Andrews) divides the vegetation into seven main types and gives an outline of the important features of each. The vegetation varies from that of typical desert in the north to humid tropical rain forest in parts of the southern Sudan.

With the cultivated crops special attention is devoted to those that are important in the region concerned, such as cotton, sorghum, sesame and the date palm. The other crops are also dealt with including some that are little known or grown only in restricted areas, such as the oil seed " kindi ", *Hyptis spicigera* Lam.

In view of the importance of weeds in agriculture some may regard the chapter devoted to this subject as disappointing, for it is restricted to three pages and deals briefly with only the worst of the weeds that the cultivator has to face. These are nut grass, lalang grass and parasites such as species of *Striga*, *Cuscuta* and *Orobanche*, the latter often troublesome with common market garden crops and vegetables such as onions, peas and beans.

The book is well supplied with photographs and maps and has a detailed and well arranged bibliography. In view of its comprehensive nature (nearly a thousand pages) and the ancillary subjects covered, it should prove of interest and value to readers in other fields besides agriculture.

F. N. Howes.

*Edited by J. D. Tothill. London, Oxford University Press, Geoffrey Cumberlege : 1948, pp. 974, price 42s. net.

A rare Canary plant in cultivation. Among some plants sent to me from South Africa by my uncle, Mr. R. N. Parker, was a specimen of an unusually striking and handsome composite cultivated at Somerset West, not far from Cape Town. This plant, unnamed except for a suggestion that it belonged to the genus *Chrysanthemum*, had neatly dissected yarrow-like leaves, and its vegetative parts entirely silvery-grey with dense short down ; the arrangement of the capitula and their individual appearance, both most reminiscent of sneezewort, increased the general resemblance to *Achillea*. In spite of this, dissection showed that the plant was undoubtedly, as suggested, a *Chrysanthemum*.

The plant, however, was not readily identifiable, but eventually an exact and perfect match was found with the original description, and the very beautiful plate accompanying it, of *Pyrethrum ptarmiciflorum* Webb, from the Canary Isles. This species is a great rarity in its native home ; there is no native specimen in the Kew Herbarium, and Pitard and Proust in their Flora of the Isles (1908) record no gathering other than the original one described by Webb. Comparatively recently, however, Burchard (Bibl. Bot. 24, Heft **98,** 202 : 1929) has rediscovered the home, so long lost, of *P. ptarmiciflorum* on Grand Canary, where it was growing in some quantity on a precipice, and flowering in May ; and he gives (t. 68) a photograph.

In reply to a request for further information Mr. Parker wrote : " As regards the *Pyrethrum ptarmiciflorum* Webb I can give you no information as to how it came out here. It is grown in the Cape Town Botanic Gardens and the Claremont garden and is called " *Artemisia argentea* " . . . . It does not appear to ripen seeds and does not root at all readily from cuttings so I doubt if it will remain long in cultivation . . . ."

A further point of interest is that this plant is (or was recently) in cultivation in Australia. There is a sheet in the Kew Herbarium collected in 1942, and stated to be cultivated by Mrs. Edith Coleman at Blackburn, Victoria.

Pyrethrum cannot be maintained generically distinct from *Chrysanthemum*, and as *P. ptarmiciflorum* is known in cultivation in two continents it seems time that its lack of a binomial under *Chrysanthemum* is remedied, and the following new combination is necessary :—

Chrysanthemum ptarmiciflorum (*Webb*) *Brenan*, comb. nov.

Pyrethrum ptarmiciflorum [" *ptarmicaeflorum* "] Webb in Barker-Webb et Berthelot, Hist. Nat. Iles Canaries **3** (2) (Phytogr. Canar. 2) p. 282, t. 111 (1836); Burchard in Bibl. Bot. 24, Heft **98,** 202, t. 68 (1929).

Pyrethrum ptarmicaefolium [sphalm.] Pitard et Proust, Iles Canaries, Fl. de l'Arch. 229 (1908), non *Pyrethrum ptarmicaefolium* Willd., Sp. Pl. **3,** 2151 (1804).

J. P. M. Brenan.

ALUMINIUM IN THE PLANT WORLD.

E. M. Chenery

Rothamsted Experimental Station, Harpenden.

Part II.

Monocotyledons and Gymnosperms

Monocotyledons

The occurrence of aluminium-accumulating species among monocotyledons was revealed by leaves of herbarium material which had dried bright yellowish green in the same way as many dicotyledons (3). Such leaves were found only in certain *Rapateaceae* and *Aletris* spp., all of which proved to be aluminium plants. Some shade-loving species of *Rapateaceae* did not dry yellowish green, yet were still strong aluminium-accumulators. Specimens from every family of monocotyledon were tested but positive results were obtained only for the plants mentioned above. Even in *Rapateaceae* seven species were not accumulators. Of these *Rapatea spruceana* Ducke only just failed to qualify and the other six were confined to the genus *Stegolepis*.

Aletris was selected for examination because Yoshii and Jimbo (6) had found, qualitatively, traces of aluminium somewhat above normal in *A. foliata* (Maxim.) Wang et Tang. Kew herbarium specimens of this plant had dried slightly yellowish, but bright yellowish green leaves were strikingly exhibited by four North American species of *Aletris*. One other Japanese species actually had its dried leaf colour perpetuated in its specific epithet : *A. luteo-viridis* (Maxim.) Franch.

The results of 269 qualitative tests are listed below in the same manner as the dicotyledons, followed by a table of quantitive results for 28 species which show the range of aluminium content. In the fractions following family and generic names the numerator (left side of stroke) is the number of aluminium-accumulating species and the denominator is the number of species tested.

ALUMINIUM IN MONOCOTYLEDONS

Hydrocharitaceae 0/1, 0/2,* *Burmanniacae* (incl. *Thismiaceae*, *Corsiaceae*) 0/5, *Orchidaceae* (incl. *Apostasiaceae*) 0/7, 0/12, *Scitaminae* (incl. *Zingiberidaceae*, *Marantaceae*, *Musaceae*, *Cannaceae*, *Lowiaceae*, *Strelitziaceae*) 0/20, *Bromeliaceae* 0/4, *Haemodoraceae* (incl. *Tecophilacaeae*, *Cyanastraceae*) 0/10, **Aletris** 5/24, 0/1 (*Liliaceae*). *Iridaceae* 0/3, 0/4, *Amaryllidaceae* (incl. *Hypoxidaceae*, *Alstroemiaceae*, *Velloziaceae*, *Agavaceae*) 0/7, *Taccaceae* 0/3, *Dioscoreaceae* (incl. *Stenomeridaceae*, *Trichopodaceae*, *Petermanniaceae*) 0/5, 0/1, *Roxburghiaceae* 0/2, *Liliaceae* (incl. *Petrosaviaceae*, *Trilliaceae*, *Philesiaceae*, *Smilacaceae*, *Ruscaceae*) 0/21, 0/26. *Philydraceae* 0/1, *Xyridaceae* 0/7, *Mayaceae* 0/1, *Commelinaceae* 0/16, 0/1.

Rapateaceae

Cephalostemon 4/4, *Monotrema* 3/3, *Rapatea* 9/10, *Saxo-fridericia* 5/5, *Stegolepis* 1/7, *Spathanthus* 3/3, *Maschalocephalus* 1/1, *Potarophytum* 1/1, *Windsoriana* 1/1.

Flagellariaceae 0/3, *Juncaceae* (incl. *Xanthorrhoeaceae*, *Thurniaceae*) 0/4, 0/3, *Palmae* (incl. *Nipaceae*, *Arecaceae*) 0/7, *Pandanaceae* 0/1, *Cyclanthaceae* 0/2,

*The second fractions are the results of Yoshii and Jimbo.

Typhaceae 0/3, 0/1, *Araceae* 0/10, 0/1, *Lemnaceae* 0/1, *Triuridaceae* 0/2, *Alismataceae* (incl. *Butomaceae*) 0/2, *Naiadaceae* (incl. *Lilaeaceae*, *Aponogetonaceae*, *Potomogetonaceae*, *Scheuchzeriaceae*, *Juncaginaceae*, *Posidoniaceae*, *Zosteriaceae*, *Ruppiaceae*, *Zannichelliaceae*) 0/12, 0/1, *Eriocaulaceae* 0/3, *Restionaceae* 0/3, *Centrolepidaceae* 0/19, *Cyperaceae* 0/10, 0/27, *Gramineae* 0/15, 0/31.

Total number of aluminium-plants : 33.
Total number of species tested : 269+107 (6)=376.

ALUMINIUM IN MONOCOTYLEDONS

	Al p.p.m.
Haemodoraceae	
Aletris aurea Walt.	4070
A. bracteata Northrop	108*
A. farinosa L.	4400*
A. foliata (Maxim.) Wang et Tang	800*
A. lutea Small	10800
A. luteo-viridis (Maxim.) Franch.	9900*
A. obovata Nash	3660
A. spicata Franch.	448*
16 Asiatic *Aletris* spp.	< 300
Amaryllidaceae	
Vellozia splendens Rendle	65
Liliaceae	
Dianella caerulea Sims	93
Commelinaceae	
Pollia condensata C. B. Clarke	468
Xyridaceae	
Xyris dicipiens N. E. Br.	150
X. indica L.	832
X. macrocephala Vahl	125

	Al. p.p.m.
Rapateaceae	
Monotrema xyridoides Gleas.	2310
Rapatea paludosa Aubl. young	7800
Rapatea paludosa Aubl. mature	13600
Rapatea paludosa Aubl. old	15000
R. spruceana Ducke	790
R. viscosa Gleas.	2840
Stegolepis angustata Gleas.	1270
S. ferruginea Bak.	123
S. guianensis Kl.	250
S. linearis Gleas.	156
S. pauciflora Gleas.	280
S. pungens Gleas.	330
24 Rapateaceae spp.	> 7000
Centrolepidaceae	
Centrolepis novoguineensis Gilb.	850
Cyperaceae	
Eleocharis equisitina J. et C. Pr.	42
Eleocharis equisitina (stunted)	1450
E. interstincta Roem. et Sch.	140
E. mutata R. Br.	120

Discussion

The above data again demonstrate the restricted occurrence of large amounts of aluminium in plants. Despite the fact that calcifuges were usually chosen for examination, accumulators were much rarer in monocotyledons than in dicotyledons. The figures for the three *Xyris* spp., and seven *Stegolepis* spp. emphasise the generic character of aluminium accumulation for both have close affinities with the strongly accumulating genera of *Rapateaceae*, besides growing in similar habitats.

Blue fruits in monocotyledons are no indication of high aluminium content as they are in dicotyledons (2). Both *Pollia condensata* C.B. Cl. and *Dianella caerulea* Sims have bright blue fruits but are not aluminium-plants. The former did contain somewhat more aluminium than the

*Mean result for two localities.

p.p.m. Parts per million or milligrams per kilo aluminium in leaves dried at 105°C. —1000 p.p.m. is the qualifying amount for an " accumulator".

average for a calcifuge (468 p.p.m. as against 206 p.p.m.) possibly on account of its comparatively high cell sap acidity (pH 5.2) which is just within the aluminium-plant range of pH 3·6–5·2. Figures within this range were obtained for the three monocotyledonous accumulators of which sufficient material was available : *Aletris farinosa* L. pH 4·6, *A. luteo-viridis* (*Maxim.*) Franch. pH 4·8, *Rapatea paludosa* Aubl. pH 4·8. The cell sap acidity range of 63 other monocotyledons (chiefly tropical) was found to be pH 5·3–7·0.* The mean, pH 6·2, is 34 times less acid than the mean for the three aluminium-accumulators. Only three other species had cell sap acidities within the pH range of aluminium-plants but two of these were at the respective limits of this range. The rarity of aluminium-accumulators among monocotyledons is thus closely connected with the rarity of species with cell sap acidities of the right order.

Qualitative tests on *Centrolepidaceae* revealed several species with aluminium contents slightly above normal. The largest amount was found in *Centrolepis novoguineensis* Gilb., but analysis showed that it fell short of the minimum for an accumulator plant.

The sedge *Eleocharis equisitina* Presl was analysed because it is the dominant species on aluminous swamp soils of Indo-China (4). A depauperate specimen from Tongking contained 1450 p.p.m. aluminium but a large healthy specimen from Siam contained only 1/35 of this amount. Aluminium ions are toxic to many plants ; the Tongking specimen might conceivably be an example of this effect as healthy specimens of two other widespread *Eleocharis* spp. also gave low aluminium figures. The *Cyperaceae* cannot, therefore, be regarded as an aluminium accumulating family on the strength of a single exceptional result. An exceptional plant in the opposite sense is *Aletris bracteata* Northrop which is a non-accumulator affiliated to strong accumulators. This is explained when soil conditions are considered : all the other North American species of *Aletris* grow in acid pine barren soils in which aluminium is readily available, whereas *A. bracteata* grows in calcareous soils in which aluminium is unavailable to the plant.

Gymnosperms

Fifty two species representing every living genus of gymnosperm were tested for aluminium accumulation and gave the following negative results : *Gnetaceae* 0/6, *Coniferae* (incl. *Ginkgoaceae*, *Araucariaceae*, *Podocarpaceae*, *Pinaceae*, *Cupressaceae*, *Taxodiaceae*, *Cephalotaxaceae*, *Taxaceae*) 0/37, 0/20 (6) *Cycadeae* 0/9, 0/1 (6).

Quantitative determinations were made on 8 species ; the figures are all normal and are consistent with those of other workers (1) :

	Al. p.p.m.
Gnetum latifolium Bl.	89
Widdringtonia cupressoides End. ...	61
Acmopyle pancheri Pilg.	31
Agathis alba Foxw.	60
Araucaria braziliensis A. Rich. ...	95
Sciadopitys verticillata S. et Z. ...	121
Pinus sylvestris L....	225
Bouvenia spectabilis Hk.	110

*Determined by the glass electrode method.

The complete absence of aluminium-accumulators from the *Coniferae* is particularly interesting as most of them have cell sap acidities within the aluminium plant range ([5]) and also grow on acid soils. This may possibly be connected with the presence of resins but in the *Cycadeae* low cell sap acidity may be responsible for the mean acidity of 5 spp. was about 6 times less than that of aluminium-plants. Cell sap acidities were only measured in two species of *Gnetaceae* and the results were, unexpectedly, typical for aluminium-plants (pH 4·7). The foregoing stresses the complexity of factors, probably involving the whole physiological make-up, which determine whether or not a plant is going to be an aluminium-accumulator.

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Part III.

Cryptogams

Although a few cryptogams in the Kew Herbarium had dried somewhat yellowish, the characteristic bright yellowish green of aluminium-accumulating spermatophytes ([4]) was never seen. Consequently the search for accumulators had to be strictly systematic with the greatest attention being paid to plants having affinity with genera already known to include aluminium-accumulators. By this means 615 new records of aluminium-accumulating species have been made but only in 4 new fern families and 2 new moss families was this character strongly developed, viz. *Marattiaceae* (excluding *Angiopteris*), *Matoniaceae*, *Loxsomaceae*, *Dipteraceae* (not universally accepted), of the ferns and *Andreaeaceae* and *Dawsoniaceae* of the mosses. Representatives of practically every genus of fern and fern ally were tested together with examples of most families of the larger Bryophytes.

The results for the ferns are arranged according to Christensen's conspectus ([5]) and the mosses according to Brotherus ([3]). As before the numerator of the fractions is the number of aluminium-accumulating species and the denominator is the number of species tested. The quantitive results which follow the qualitative were obtained by the " aluminon " colorimetric method adapted for use with the " Spekker " absorptiometer. Special care was taken to select the cleanest material and very thoroughly washing it with hot 50% alcohol acidified slightly with nitric acid.

ALUMINIUM IN CRYPTOGAMS

PTERIDOPHYTA

Filicinae

Ophioglossales

Ophioglossaceae 0/7, 0/1 ([6]), 1/5 ([14]).

Marattiales

Angiopteridaceae : *Angiopteris* 18/22, 1/1 ([14]), *Macroglossum* 1/1, *Archangiopteris* 2/2. *Marattiaceae* : *Marattia* 28/29, *Christensenia* 3/3, *Danaea* 20/20.

Filicales

Osmundaceae 0/5, 0/3 ([14]), *Schizaeaceae* 0/9, 0/1 ([14]), *Marsileaceae* 0/5, 0/1 ([6]), 0/1 ([14]). *Gleicheniaceae* : *Gleichenia* 63/65, 2/2 ([14]), *Platyzoma* 0/1, *Stromatopteris* 0/1. *Matoniaceae* : *Matonia* 2/3. *Hymenophyllaceae* 0/3, 0/4 ([14]), *Trichomanes* 1/7. *Loxsomaceae* : *Loxsoma* 1/1, *Loxsomopsis* 1/1. *Hymenophyllopsidaceae* 0/1. *Plagiogyriaceae* : *Plagiogyria* 10/19, 2/2 ([14]). *Dicksoniaceae* 0/25, *Cibotium* 1/7. *Cyatheaceae* : *Lophosoria* 0/1, *Metaxya* 0/1, (*Protocyatheaceae*) *Alsophila* 86/156, 1/1 ([6]), 2/2 ([14]), *Hemitelia* 51/64, *Cyathea* 147/199, 1/1 ([6]), 1/1 ([14]). *Polypodiaceae* 0/203, 0/55 ([14]), 0/2 ([6]), *Tapeinidium* 4/5, *Blechnum* 3/56, *Asplenium* 0/7, 1/1 ([14]), *Dryopteris* 0/5, 1/1 ([14]), *Polystichum* 0/3, 2/2 ([14]), *Dipteris* 5/5 (*Dipteridaceae*), *Cheiropleuria* 1/1. *Salviniaceae* 0/1, 0/1 ([6]), 0/2 ([14]), *Azollaceae* 0/1.

Equisetinae

Equisetaceae 0/3, 0/1 ([6]), 0/4 ([14]).

Lycopodinae

Lycopodiaceae : *Lycopodium* 27/81, 3/3 ([8] [12] [13]), 4/6 ([6]),* 3/7 ([14]),* 13/19* ([11]), *Phylloglossum* 1/1, *Selaginellaceae* 0/7, 0/1 ([6]), 0/4 ([14]), *Isoetaceae* 0/3, 1/2 ([14]).

Psilophytinae

Psilotaceae 0/4, 0/1 ([6]), 0/1 ([14]).

BRYOPHYTA

Musci

Spagnobrya : *Sphagnales* 0/8.

Andreaobrya : *Andreaeales* : *Andreaea* 46/51.

Eubrya : *Fissidentales* 0/2, *Archidium* 2/4. *Dicranales* 0/10, *Ditrichum* 2/7, *Leucobryum* 1/1 ([14]). *Pottiales* 0/15, *Calymperes* 2/6, *Grimmiales*

*Retested species of earlier workers not included.

0/3, *Funariales* 0/2, *Schistostegiales* 0/1. *Tetraphidales*: *Tetraphis* 2/3. *Eubryales* 0/19, *Mnium* 1/1 (14). *Isobryales* 0/23, *Myurium* 4/5, *Camptochaete* 1/1, *Trachypus* 1/1 (14). *Hookeriales* 0/5, *Hypoterygium* 1/2. *Hypnobryales* 0 23, *Acroporium* 1/3, *Hypnum* 1/2. *Buxbaumiales* 0/1. *Polytrichinales* : *Catharinaea* 1/9, *Rhacelopus* 1/1, *Oligotrichum* 4/4, *Psilopilum* 2/4, *Lyellia* 1/1, *Pogonatum* 32/37, 4/4 (14), *Polytrichum* 20/28, 2/2 (14), *Polytrichadelphus* 5/7, *Dendroligotrichum* 2/2. *Dawsoniales* : *Dawsonia* 7/7.

Hepaticae 0/19, 0/6 (14).

Bazzania 1/1 (14), *Scapania* 4/4 (14), *Anthoceros* 1/6.

CHAROPHYTA

Characeae : *Chara* 1/5.

THALLOPHYTA

Algae 0/15, Lichenes 0/3, 0/2 (14), Fungi (terrestrial) 0/23, 0/1 (1).

ALUMINIUM IN CRYPTOGAMS

PTERIDOPHYTA

	Al p.p.m.
FILICINAE†	
Ophioglossaceae	
Botrychium ternatum (Thbg.) Sw.	780
Angiopteridaceae	
Angiopteris albido-punctulata Ros.	5830
A. angustifolia Pr.	3470
A. arborescens (Blanco) Merr.	580
A. brooksii Cop.	9880
A. cordatiformis Hier.	1750
A. evecta (Forst.) Hffm.	7600
A. fokiensis Hier.	947
A. javanica Pr.	4450
Macroglossum alidae Cop.	5200
Archangiopteris tamdaoensis Hay.	10900
Marattiaceae	
Marattia attenuata Lab.	821
M. fraxinea Sm.	3340
M. kaulfussii J. Sm.	1260
,, ,, ,,	530**
M. verscheffeltiana (de Vr.) Sturm	1870
Christensenia aesculifolia Maxon	16000
Danaea elliptica Sm.	19700‡
D. excurrens Ros.	13400
Danaea fendleri Und.	10300
D. oligosora Fourn.	5170
D. simplicifolia Rudge	29300
Gleicheniaceae	
Platyzoma microphyllum R. Br.	310
Gleichenia alpina R. Br.	3000
G. bifida (Willd.) Spr.	1290
G. cunninghamii Hew.	4840
G. elongata Bak.	100
G. flagellaris (Bory) Spr.	3390
G. glauca (Thbg.) Hk.	8620
G. laevissima Christ	8950
G. longipinnata Hk.	3300
G. maritima Hier.	8710
G. revoluta HBK.	15100
Matoniaceae	
Matonia pectinata R. Br.	8350
Hymenophyllaceae	
Trichomanes membranaceum L.	1750
Loxsomaceae	
Loxsoma cunninghamii R. Br.	4040
Loxsomopsis lehmannii Hier.	9050
Plagiogyriaceae	
Plagiogyria pycnophylla (Kze.) Mett.	7800‡
P. semicordata (Pr.) Christ	1800‡

**mean of two or more localities.

†fertile fronds were used unless marked‡.

	Al. p.p.m.
Dicksoniaceae	
Dicksonia antarctica Lab.	83
Thyrsopteris elegans Kze.	160
Cyatheaceae	
Lophosoria pruinata Pr.	86
Metaxya rostrata Pr.	340**
Alsophila arbuscula Pr.	13500
A. caudata J. Sm.	4930
A. excelsa R. Br.	8100
A. gibbosa Kl.	4930
A. glauca (Bl.) J. Sm.	9700
A. leuçolepis Mart.	17300
A. sagittifolia Hk.	3700
A. scaberulipes v.A.v.R.	5560
A. senilis Kl.	6000
A. squamulata (Bl.) Hk.	11000
Hemitelia barisanica v.A.v.R.	14300
H. crenulata Mett.	3580
H. grandifolia (Willd.) Spr.	13700
H. karsteniana Kl.	3200
H. junghunhiana (Kze.) Mett.	5650
H. wilsoni Hk.	5580
Cyathea affinis (Forst.) Sw.	9020
C. arachnoidea Hk.	22900
C. assimilis Hk.	5710
C. caribaea Jenm.	21600
C. hookeri Thw.	2990
C. parksiae Cop.	5680
C. propinqua Mett.	17300
C. pubescens Mett.	4460
C. sinuata Hk. et Grev.	6360
Polypodiaceae	
Tapeinidium pinnatum (Cav.) C. Chr.	7140
Blechnum diversifolium Mett.	23200
B. frazeri (A. Cunn.) Luers.	8650
B. lenormandi (Bak.) Diels	22500
B. occidentale L.	270
B. orientale L.	390
B. patersoni (R. Br.) Mett.	560
B. serrulatum L. C. Rich.	145
B. volubile Klf.	500
Asplenium incisum Thbg.	2480
Acrophorus stipellatus (Wall.) Moore	185
Dryopteris miquelcna (Maxim.) C. Chr.	1890
Polystichum tripteron (Kze.) Pr.	995
Dipteris conjugata Reinw.	4060
Cheiropleuria bicuspis (Bl.) Pr.	16300‡
Platycerium bifurcatum (Cav.) C. Chr.	
(growing on cliffs)	550
(growing on trees)	45
Christiopteris sagitta (Christ) Cop.	350‡
C. tricuspis (Hk.) Christ	115‡
C. varians (Mett.) Cop.	210‡
Neocheiropteris palmatopedata (Bak.) Christ	650
Holtumiella flabbellifolia (Bak.) Cop.	480
Leptochilus lanceolatus Fée	230
L. zeylanicus (Houtt.) C. Chr.	275
Polypodium hemionitideum Wall.	76
Elaphoglossum petiolatum (Desv.) Moore	230
Lycopodiaceae	
Lycopodium scariosum Forst. var. *raciborskii* Hert.	10300
L. volubile Forst.	2560
Phylloglossum drummondii Kunze	3300
Isoetaceae	
Isoetes asiatica Mak.	2160
BRYOPHYTA	
MUSCI	
Sphagnobyra	
Sphagnum cuspidatum Ehrh.	330
S. rigidum W. P. Sch.	280
Andreaobrya	
Andreaea nivalis Hk.	4500
A. novae-zelandiae Schimp.	11500
A. petrophila Ehrh.	9650
Eubyra	
Archidium indicum Hpe. et C. M.	6500

	Al. p.p.m.
Campylopus subulifolium Thw. et Mitt.	427
Dicranium fragile Hk.	720
Encalypta procera Bruch	610
Calymperes hampei Doz. et. Mk.	1360
Grimmia patens (Dicks.) Br. eur.	1530
Georgia pellucida (L.) Rab.	1140
Spiridens vieillardi Schimp.	725
Mniodendron fusco-mucronatum (C. M.) Broth.	750
Myurium hebridarum Schimp.	1600
Prionodon lycopodiodes Hpe.	1180
Camptochaete spurio-deflexa (C. M.) Broth.	1100
Hypoterygium laricinum (Hk.) Brid.	1400
Hypnum callichroum (Brid.) C. M.	1900
Buxbaumia aphylla L.	310
Lyellia crispa R. Br.	1500
Pogonatum macrophyllum Doz. et Mk.	8600
Polytrichum serratulum Hpe.	2500
Dendroligotrichum dendroides (Hedw.) Broth.	1320
Dawsonia altissima Geh.	5100
D. polytrichoides R. Br.	2080
HEPATICAE	
Madotheca leiboldii Lehm.	600
Pleurozia cochleariformis Dum.	130
Radula voluta Tayl.	260
Anthoceros dendroceroides St.	2100
CHAROPHYTA	
Chara vulgaris L.	1450
THALOPHYTA	
Cladonia sylvatica Hoffm.	85

Summary

	Pteridophyta		
Aluminium Plants	476+3 ($^{8\ 12\ 13}$)+6 (^{6})+17 (^{14})+13 (^{11}) =515		
Species Tested	1044+3 ($^{8\ 12\ 13}$)+12 (^{6})+100 (^{14})+19 (^{11}) =1178		
	Bryophyta	Charophyta	Thalophyta
Aluminium Plants	138+15 (^{14}) =153	1	None
Species Tested	311+28 (^{14}) =339	5	41+2 (^{14})+1 (^{1})=44

BRYOPHYTA

Discussion

Apart from the close connection of aluminium accumulation with taxonomy, which has been evident throughout this survey, the most significant feature of the qualitative results for the ferns is the fact that aluminium-accumulators are almost entirely confined to ancient families and genera. Affinities between them are usually remote but they are comparatively close between the *Gleicheniaceae*, *Matoniaceae*, *Dipteraceae* and *Cheropleuria*. It is interesting to note that the two genera *Lophosoria* and *Metaxya* *Amphidesmium* maintained by Bower [2] as linking the *Cyatheaceae* with *Gleicheniaceae* proved to be non-accumulating. *Tapeinidium* and *Cheiropleuria* are noteworthy as they are regarded by Christensen as the most primitive genera of their respective sub-families of the *Polypodiaceae*. *Dipteris* is considered by Copeland [7] as the most primitive of all polypods. The three aluminium-accumulating species of *Blechnum* : *B. diversifolium*, Mett., *B. fraseri* (A. Cunn.) Luers. and *B. lenormandi* (Bak.) Diels are anomalous in that genus on account of their bipinnate fronds, which according to Copeland justifies the raising of *B. fraseri*, and presumably the other two species, to separate generic rank.

Von Faber [10] in his study of Javanese solfatara-plants recorded *Polypodium feei* Bory, Mett. as being a strong aluminium-accumulator. Nine specimens of this plant (including terrestrial forms) were tested but they gave negative or doubtful results.

The results for the fern allies confirmed those of previous workers especially those of Hutchinson and Wollack [11] who found that the sub-genus *Urostachys* of *Lycopodium* was only slightly aluminium-accumulating. All the terrestrial *Lycopodium* spp. available at Kew have now been tested : only 5 species out of 48 of *Urostachys* were aluminium-accumulators while the rest of *Lycopodium* gave 22 accumulators out of 33 species tested.

Of the lower cryptogams the mosses contained the largest number of accumulators, the strongest occurring in the morphologically primitive sub-class Andreaobrya. In the Eubrya moderate accumulators were found sporadically in several orders but strong accumulators were concentrated in the morphologically advanced *Polytrichinales* and *Dawsoniales*.

The quantitive data amply support the findings of the qualitative survey. The number of species analysed from the larger genera was roughly in proportion to the number of accumulators in the genus unless specially selected for reasons mentioned below. *Botrychum ternatum* Sw. was found by Yoshii and Jimbo [14] to be an accumulator ; the specimen analysed also came from Japan but failed to qualify. *Angiopteris evecta* Hoffm. was rather variable in that several specimens contained only moderate amounts of aluminium, as was found by Yoshii and Jimbo, but the specimen analysed contained the relatively large amount of 7600 p.p.m. *Angiopteris arborescens* (Blanco) Merr. and *A. fokiensis* Hiern. failed to reach the 1000 p.p.m. level but they showed some tendency to accumulate aluminium ; the material analysed may possibly have been from young plants. *Angiopteris brooksii* Cop., which contained the largest amount of aluminium in the genus, displayed the nearest approach to yellowish green drying leaves that was seen in the ferns. Eight specimens of *Marattia kaulfussii* J. Sm. were tested qualitatively with negative or

doubtful results ; one of the latter did actually, just qualify as an accumulator when analysed. This species is interesting because it is sometimes separated ([7]) from *Marattia* as the type of the genus *Eupodium*. The largest amount of aluminium found in any cryptogam occurred in *Danaea simplicifolia* Rudge with 29300 p.p.m. or about 3% of the dry frond.

In the *Gleicheniaceae* the monotypic genera *Platyzoma* and *Stromatopteris* and two species of the section *Eugleichenia* were non-accumulators but still this family is the most constantly aluminous of the larger families of the *Filicales*. Included in the *Matoniaceae* is a peculiar non-accumulating species which is notable for its extremely local habitat in certain limestone caves of Borneo and having been elevated to separate generic rank by Copeland. The two other members of this family form societies with *Dipteris* and *Cheiropleuria* in Malaya and the East Indies.

Moderate accumulators may occur in the Hymenophyllaceae of which *Trichomanes membranaceum* L. is an example, but they are probably not common. The related family Loxsomaceae appears to be wholly aluminium-accumulating ; it consists of 4 species which according to Bower have characteristics which suggest antiquity and survival. The *Dicksoniaceae* also have affinities with the *Loxsomaceae* but only one species is aluminium-accumulating. The separation of *Dicksoniaceae* from the strongly accumulating *Cyatheaceae* should be mentioned here as a good example of differences in aluminium content coinciding with morphological differences. The *Cyathaceae* proved to be the family with the largest number of aluminium-accumulators (289 species). The proportion of accumulators in *Alsophila* was much less than in the other two genera but whether this has taxonomic importance is doubtful as the three genera grade into each other.

The largest amount of aluminium found in the *Filicales* occurred in *Blechnum diversifolium* Mett. with 23,200 p.p.m. The two other *Blechnum* spp. with bipinnate fronds also gave aluminium figures which stand out prominently from those of the other species of the same genus. These species were discovered when the whole genus was tested because Yoshii and Jimbo had previously found two accumulating *Plagiogyria* spp. which in the Kew Herbarium are included as a section of *Blechnum* (*Lomaria*). Yoshii and Jimbo found aluminium by their alizarin test in 4 species of *Polypodiaceae* ; 3 of these species, *Asplenium incisum* (Thbg.) Wall., *Dryopteris miquelana* (Maxim.) C. Chr., and *Polystichum tripteron* (Kze.) Pr., have now been analysed and the results show that they are moderate accumulators.

Cheiropleuria bicuspis (Bl.) Pr. was examined in the first place on account of its affinities with *Dipteris* spp. ; the quantitative result indicates that it is a very strong aluminium-accumulator. Other dipteroid ferns of the genera *Platycerium*, *Christiopteris*, and *Neocheiropteris* were all non-accumulators *Holtumiella flabellifolia* (Bak.) Cop. which was provisionally placed among the dipteroids by Copeland also proved to be non-accumulating. Dixon ([9]) reported high contents of aluminium in epiphtic species of *Platycerium* but these were not confirmed in the present study, even in a specimen which had grown on a cliff. The last four species of fern in the list were analysed because they are among the few terrestrial polypods but again all the results were normal.

The two *Lycopodium* spp. were analysed since they are comparatively advanced and it was thought that they might contain exceptionally large amounts of aluminium but this was not the case (cf. Hutchison and Wollack). *Phylloglossum* displayed its relationship to *Lycopodium* by being an aluminium-plant. *Isoetes asiatica* Mak. was analysed in order to check Yoshii and Jimbo's positive result. It qualified as a moderate aluminium-accumulator but in view of the negative results obtained with other species this may have been due to diffusion through stems and leaves from exceptionally aluminous water.

The quantitative data for the lower cryptogams show that few species can be classed as strong aluminium-accumulators and none attain the higher concentrations reached in the ferns.

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A NEW SPECIES OF POA FROM PAPUA.

C. E. Hubbard.

The following new species of *Poa* is one of several plants of exceptional interest in a collection made by the Rev. N. C. G. Cruttwell on Mt. Simpson (9972 feet), a hitherto botanically unexplored mountain and the most easterly high peak of the Owen Stanley Range in the North East Division of Papua. The collector informs us that above 8000 feet, the woody vegetation ceases except for a few stunted shrubs, mostly dead. In this area, *Pteridium aquilinum* and another fern of similar habit are dominant in ground composed of typical mountain-top detritus with scattered rock fragments everywhere and bare peat between. There are, however, many bare patches where other plants, including the new *Poa*, are prominent.

Poa cruttwellii *C. E. Hubbard*, sp. nov. ; a *P. plebeia* R. Br., culmis et foliorum vaginis superioribus scabridis, spiculis multo majoribus laxe 4–6-floris, lemmatibus longioribus obtusis scabridis differt.

Gramen perenne, dense caespitosum, innovationibus intravaginalibus, usque 45 cm. altum. *Culmi* erecti, graciles, simplices, 3-nodes, rigidiusculi, leviter compressi, glabri, paniculam et nodos versus scabridi. Folia glauciuscula, fere glabra ; vaginae persistentes, inferiores et intermediae superne compressae et carinatae, laeves vel fere laeves, ore minute ciliolatae, ceterum glabrae, imbricatae, superiores arcte appressae, scabridae, internodiis demum breviores ; ligulae brevissimae, truncatae, membranaceae, apice minute ciliolatae ; laminae anguste lineares, apice abrupte acutae, usque 22 cm. longae et explanatae 3 mm. latae, arcte convoluto-conduplicatae (marginibus convolutis), erectae, rigidiusculae, glabrae, carina et marginibus apicem versus scabridae, ceterum laeves. *Panicula* laxa, ovata, usque 12 cm. longa et 6 cm. lata ; rhachis flexuosa, scabrida ; rami patentes, tenuiter filiformes, flexuosi, scaberrimi, inferiores 3–5-nati, usque 6 cm. longi, laxe 2–7-spiculati ; pedicelli valde inaequales, 1–6 mm. longi, scabridi. *Spiculae* late ovato-oblongae vel oblongae, 9–12 mm. longae, 4–6 mm. latae, laxe 4–6-florae, purpureotinctae ; internodia rhachillae laevia, 1–1·5 mm. longa. *Glumae* acutae vel subobtusae, marginibus membranaceis exceptis firme herbaceae, prominenter nervatae, lateribus minute scaberulae, carina scabridae ; inferior explanata oblongo-lanceolata, 4–5·5 mm. longa, 3-nervis ; superior explanata anguste ovato-oblonga, 5·5–6·5 mm. longa, 3–5-nervis. *Lemmata* scabrida, a latere visa anguste oblonga vel oblique lanceolato-oblonga, obtusa, prominenter 7-nervia, apicibus et marginibus angustis hyalinis exceptis demum coriacea, carina et nervis exterioribus basin versus minute pubescentia, basi fasciculo pilorum alborum debilium crispulorum praedita, inferiora 5·5–7 mm. longa. *Paleae* anguste oblongae, obtusae, lemmate breviores inter carinas dense scabridociliatas, minutissime papillosae. *Antherae* 3 mm. longae.

Papua. North East Division : Owen Stanley Range ; Mt. Simpson, 2990 m., in mountain-top detritus, on the knife-edge summit amongst rocks, 28-10-1947, *Cruttwell* 61.

SOME NEW OR NOTEWORTHY AMARANTHACEAE FROM EAST AFRICA.

K. Suessenguth—Munich.

Achyranthes aspera *L.* forma **monstrosa** *Suessenguth*, forma nov.

Inflorescentia non spica simplex, sed e multis spicis lateralibus 2–5 cm. longis axi centrali 7 cm. longi affixis composita. Omnes *racemuli* bracteis instructi, quae autem tandem *flores* valde rudimentarios minimos vix 0·5 mm. longos includunt. *Tepala*, *stamina* et *ovaria* in floribus desunt. Haec forma monstrosa formas similes *Celosiae cristatae* in memoriam revocat ; species *Celosiae* autem huc non praestatur, quia folia et rhachis etc. non *Celosiae* sunt, sed *Achyranthis*.

Zanzibar. Without locality, 1944, *M. Davies* in Amani Herb. no. 9684.

Achyropsis greenwayi *Suessenguth*, spec. nov.

Planta perennis ramosa, ad 60 cm. alta, pilosa ; caulis teres, striatus, ramuli pubescentes, adscendentes ; internodia ad 6 cm. longa. *Folia* subsessilia, oblongo-lanceolata, acuta, apice brevissime mucronulata, ad 2 cm. longa, ad 0·6 cm. lata, supra pilis adpressis densis instructa, infra talibus pilis dense albide sericea. *Spicae* terminales ; pedunculus ad 5 (–8) cm. longus ; spica ad 1·2 cm. longa, ad 6 mm. lata, non lana involuta ; rhachis tandem breviter pilosa ; bracteae quam tepala multo breviores, late ovatae, pellucidae. *Tepala* 5, oblonga, glabra, straminea, c. 3 mm. longa. *Stamina* 5, filamentis subulatis ; pseudostaminodia lanceolata (non rectangula !), apice acuto fimbriis c. 3 brevissimis instructo. *Germen* subglobosum, viride ; stylus longus, glaber.

Kenya Colony. Mile 24 old [Nairobi to] Kajiado road, common in dry open country, 23 Mar. 1941, *Bally* 1451, Kew.

Tanganyika Territory. W. Slopes of Kilimanjaro, Ngari Rongi Plain, c. 1350 m., 7 July 1943, *Greenway* 6740, Kew (type) and Amani. Kilimanjaro, grass-desert at Olmslog, 1400–1500 m., Jan. 1909, *R. Endlich* 167, Munich.

" Locally common but scattered in *Pennisetum mezianum*, *Digitaria scalarum*, *Hyparrhenia rufa*, *Sporobolus*-grassland with locally dominant *Indigofera spinosa*, *Sphaeranthus* sp., *Bothriochloa insculpta* and *Cynodon plectostachyum* " (Greenway in sched. 6740).

The species belongs to the series without wool on the inflorescence and with 5 tepals ; it differs from *A. leptostachya* Hook. f. by the leaves being sericeous below, the number of tepals, the longer peduncles and the pseudostaminodia.

Aerva sansibarica *Suessenguth*, spec. nov.

Herba (teste Greenway) procumbens, ramulis sublignosis glabris 1–2 m. longis teretibus substriatis 2 mm. crassis ; ramuli laterales in specimine collecto retroversi (angulo c. 150°), ad 30 cm. longi, eramosi, glabri. *Folia* tandem in ramulis lateralibus praesentia, alternantia, internodiis c. 1–2 cm. longis disjuncta, ad 3 cm. longa, c. 5 mm. lata, oblanceolata, utrinque subglabra vel glabrata (pili stellati desunt), non

conspicue petiolata, sed ad nodum decurrentia, huc attenuata, subcoriacea, apice acuto, nervis lateralibus in utroque costae latere c. 3, superne vix, subtus paulum conspicuis, marginibus subrevolutis, subincrassatis. *Glomeruli florum* axillares, neque in spicam terminalem conjuncti, albi, pilis dense vestiti, pauciflori, parvi, globosi vel ellipsoidei, 3–5 mm. longi, 3 mm. lati. Omnes *flores* praesentes feminei, pseudostaminodiis deficientibus. *Tepala* 5, extus dense albo-pilosa, lanata. *Ovarium* in patellam basalem integram impositum, lageniforme, glabrum, in stylum gradatim attenuatum. *Stigma* subbilobum.

Zanzibar. Pwani Mchangani, 26 Jan. 1929, *Greenway* 1202, Amani (type) and Kew. "A procumbent herb growing on sand, near the sea shore, fairly common" (Greenway).

Celosia populifolia *Moq.* in DC. Prodr. **13** (2), 239 (1849).

var. **pluriovulata** *Suessenguth*, var. nov.

Ovarium 4–5 (–8) ovula includens. *Inflorescentia* paniculata brevis, ad 8 cm. longa, subdensa. *Frutex* c. 1–2 m. altus.

British Somaliland. 112 Km. from Boramo, 690 m., 28 Febr. 1945, *Glover & Gilliand* 833, Kew (type). Mwred valley, 750 m., 13 Febr. 1945, *Glover & Gilliland* 727, Kew. Nomina vernac. : Maranpfur & Hagau Paune.

Hochstetter found the capsule of *C. populifolia* var. *typica* 1-seeded, as did Baker and Clarke (Fl. Trop. Afr. **6** (1), 24 : 1909) " in abundant material " ; Moquin found 2–4 seeds. Our plants have a shorter panicle than the typical species.

Celosia stuhlmanniana *Schinz* in Bull. Herb. Boiss. **4,** 419 (1896).

Tanganyika Territory. Bukoba District, Kabiriyi, Oct. 1931, 1170 m., *A. E. Haarer* 2218, Amani.

Ovarium plerumque monospermum. Teste Schinz, l.c., 1–2-spermum. Baker in Fl. Trop. Afr. **6** (1), 17 (1909) states " capsule several-seeded ".

Neocentema *Schinz* in Vierteljahrsschr. Naturf. Gesellsch. Zürich **56,** 243 (1911).

H. Schinz has placed this genus in the subtribe *Achyranthinae* (see Natürl. Pflanzenfam. ed. 2, **16**c, 24 : 1934). Investigations of *N. alternifolia* (Schinz) Schinz, however, proved that the tip of root of the embryo is in the seed pointing in a *downward* direction. *Neocentema* is therefore to be placed in the *Amaranthinae*, having affinity with *Digera* Forsk.

The genus *Neocentema* differs from the related genera in its partial inflorescences with 3 flowers and 4 sterile rudiments, and also by its crenate inner perianth-leaves, by the two apical sulcations of its compressed ovary and by its thorny partial aggregates of fruits remaining united and growing strongly after flowering. Its relationship to *Digera* may be assumed owing to its habit, the structure of its ovary (that of *Digera* being also a bit compressed, with an apical torus but without sulcations) and its appearing as a " weed ". The diagram of its partial inflorescence corresponds in a high degree to that of *Pupalia* Juss. ; see Schinz in Nat. Pflanzenfam. ed. 2, **16**c, 14, fig. 5E (1934). There also

the same strange symmetry of ovaries is to be observed : the longitudinal axis of the ovary of the middle flower lies in the median line of the diagram, that of the ovaries of both side-flowers, however, is situated in the transverse axis. Nevertheless *Neocentema* cannot be attached to *Pupalia*, the location of the ovule being that of *Amaranthinae* and not of *Achyranthinae*. The conformity with *Pupalia* is therefore to be regarded as convergence. Its four sterile flowers are not changed into a ctenoid form as in *Digera*, but grow into hard four-thorned scales.

Material investigated : *N. alterifolia*. Tanganyika Territory. South Massai Grassland, *Stuhlmann* 4287 (Munich) cotype. S. Mbulu District, S. slopes of Mt. Hanang, Katish, 2230 m., 15 Febr. 1946, *Greenway* 7750, Kew & Amani. " Locally dominant in abandoned native maize and bean cultivations with *Cynodon dactylon*, *Digitaria scalarum* and *Cyperaceae* in a dark greyish brown loam of volcanic origin " (Greenway).

General notes : In *Amaranthinae* as well as in *Achyranthinae* the ovule arises from the base of the ovary and is first of all anatropous. But whereas in *Amaranthinae* the ovule remains anatropous, in *Achyranthinae* a further elevation of the ovule makes the micropyle turn upwards. The examination of the ripe seed is decisive.

To the genera of *Amaranthinae* mentioned by Schinz (l.c.) there must be added moreover *Pseudodigera* Chiovenda, Fl. Somal. **3,** 149 (1936), which differs from *Digera* in the absence of sterile, cristate flowers and from *Lagrezia* Moq. by its nut-like fruit (Chiovenda) with hard pericarp.

Pandiaka fasciculata *Suessenguth*, spec. nov.

Suffrutex perennis, *scandens* ; caules dense pubescenter tomentelli (pilis adscendentibus) ; ramuli florentes eramosi ; internodia ad 8·5 cm. longa, longitudinaliter striata. *Folia* opposita, ovata, acuta, supra pubescentia, subtus (imprimis in nervis albis pinnatis e lamina subtus subelevatis) sericeo-pilosa, ad 4·5 cm. longa, ad 2·5 cm. lata ; petioli ad 0·8 cm. longi. *Inflorescentia* tota apicalis, e spica terminali 1 et spicis lateralibus circiter 5 fasciculatis constructa. *Spicae laterales* vix (vel infimae ad 2·5 cm.) pedunculatae ; internodia inter spicam terminalem et spicas inferiores brevia ; spicae infimae ad 1·8 cm. a superioribus distantes ; spica terminalis ad 5 cm. longa, laterales breviores ; rhachis spicae dense albido-tomentella. *Flores* eis *Pandiakae obovatae* Suessenguth et *P. Carsoni* C. B. Clarke* similes, argyracei ; bractea scariosa, uninervia, tenuis, 2–2·5 mm. longa ; bracteolae uninerviae, 3–4 mm. longae, acutissimae, spina terminalis recta, subtus elevata. *Tepala* 6–7 mm. longa, glabra, trinervia. *Pseudostaminodia* 5, subtrilobata, lobis apice in fila laceratis. *Ovarium* uniovulatum, ellipsoideum, sulco mediano plano transverso subconstrictum. *Flores fructiferi* horizontaliter patentes vel paululum reclinati.

Tanganyika Territory. S. Mbulu District, S.E. Slopes of Mt. Hanang, Nangwa, c. 2700 m., 6 Febr. 1946, *Greenway* 7620†, Kew (type). " On a steep slope in a dark brown loam of volcanic origin, growing over *Acanthaceae*, *Pavonia irakuensis*, *Abutilon longicuspe* secondary bush in

*In *Fl. Trop. Afr.* **6** (1), 70 (1913).

†According to Greenway, this species is also represented at Amani by *Lindeman* 846.

open *Cassipourea eickii*, *Podocarpus gracilior*, *Ekebergia*, *Teclea* sp. dry evergreen forest ". Hanang or Guruwe Mt., in *Hypericum lanceolatum*, *Erica arborea* forest, c. 2700 m., 26 Dec. 1929, *Burtt* 2262, Kew. Ngorongoro Crater, west summit above Laroda, in forest margin, 2400 m., *Burtt* 4308, Kew. Ngorongoro rest camp, 1800 m., 3 Apr. 1941, *Bally* 2232, Kew. West Arusha Province, Embagani* Mt., in open upland grassland, 2400 2550 m., 5 Febr. 1932, *St. Clair-Thompson* 1414, Kew.

Species proxima *Pandiakae obovatae* Suessenguth in Bull. Jard. Bot. de l' État, Bruxelles **15** (1), 67 (1938), sed foliis ovatis, non obovatis, spicis fasciculatim positis, non spica unica terminali ; planta scandens. Propter flores vix reclinatos, bracteolas rectas non ad *Achyranthem* ponenda. Confer K. Suessenguth, " Neue Amarantaceen aus Rhodesia und Angola, mit einer Übersicht der Gattung *Pandiaka* ", in Botan. Archiv. **41,** 72–85 (1940).

Psilotrichum africanum *Oliv.* var. **pilosum** *Suessenguth*, var. nov. ; a *P. africano* typico recedit internodiis pilosiusculis, foliis minoribus (ad 3 cm. longis, ad 1·8 cm. latis) subtus dense pilosis in sicco rubellonigrescentibus, pedunculis tepalisque longius pilosis.

Uganda. Masaka District, Kabula, alt. 1350 m., Sept. 1945, *J. H. Purseglove* 1824, Amani (type), Kew and Herb. Dep. Agr. Uganda.

Psilotrichum amplum *Suessenguth*, spec. nov. ; sect. *Psilostachys* Baker et Clarke, Fl. Trop. Afr. **6** (1), 58 (1913).

Planta inter frutices divaricatim scandens (" straggling " ; caulis striatus, dense breviter subtomentosus. *Folia* alternantia, petiolata, in specimine praesente ad 2·3 cm. longa, ad 2 cm. lata, late ovata, apice mucronulata, basi lata breviter in petiolum contracta, utrinque pilis simplicibus subaccumbentibus obtecta ; petiolus 0·5-plerumque 2 cm. longus, breviter pilosus. *Inflorescentia* ampla, c. 35 cm. longa, 25 cm. lata, terminalis, omnino aphylla, paniculata ; ramuli omnes graciles, floriferi spicati ; internodia basalia c. 5 cm. longa, flores in spatiis 0·5–1 cm. longis distantes. *Bracteae* (non florigerae) inferiores lineares, infirmae, uninerviae, c. 2 mm. longae. *Tepala* 3 4 mm. longa, ecostata, trinervia, pilis longis sursum tepala superantibus flavescentibus porrectis instructa. *Stamina* 5, filamentis infirmis taeniatis. *Ovarium* ovoideum, stylo longo, stigmate cocciformi.

British Somaliland. Between Wardere and Walwal, 22 Nov. 1944, *Glover & Gilland* 402, Kew (type) and Amani. " Quite frequent straggling through bush bases ". Nomen vernac. : Bandregole.

The species may be placed between *Ps. gnaphalobryum* Schinz and *Ps. gloveri* Suesseng. The individual flowers are like *Ps. gloveri* but are a little less hairy, whilst the very large inflorescence resembles that of *Ps. gnaphalobryum*. *Ps. amplum* is distinguished from *Ps. gloveri* amongst other things by the very large terminal panicle and the much less hairy leaves, and from *Ps. gnaphalobryum* by the long-haired tepals without ribs as well by the leaf-shape.

*The spelling of this name is doubtful, as the collector's handwriting is difficult to interpret.

Psilotrichum gloveri *Suessenguth*, spec. nov. ; sect. *Psilostachys* Baker et Clarke, Fl. Trop. Afr. **6** (1), 58 (1913).

Frutex parvus, c. 45 cm. altus, e collo centrali abbreviato 3–8 cm. longo ad 5 mm. crasso lignoso, ramos plures 15 (40) cm. longos, teretes divaricati emittens ; cortex ramorum dilute brunneus, longitudinaliter subrugosus, internodiis c. 3 cm. longis teretibus multis pilis tenuibus accumbentibus subtomentosis postea glabrescentibus ; internodia superiora hornotina, dense subtomentosa, albo-viridula, pilis paucis multo longioribus intermixtis. *Folia* integra, opposita, ovata vel elliptica, ad 2·5 cm. longa, ad 2 cm. lata, petiolis 0·5–1·5 cm. longis, dense pilosis ; folia imprimis juniora subtus pilis simplicibus non glutinosis epidermidi partim accumbentibus nec basi incrassatis dense tomentosa, supra laxius pilis similibus obtecta, apice subrotundata, basi brevissime cuneatim contracta ; nervi utrinque 4–5, arcuatim ad marginem adscendentes, subtus partim obsoleti. Pili stellati totae plantae deficiunt. *Ramuli* non in comas foliorum exeuntes. *Paniculae* (vel racemi) 5 cm. longae, axillares, erecto-patentes, pedunculis gracilibus, tenuibus, 3 cm. longis, glabris, floribus antice laxe dispositis, bracteae minimae, pellucidae, uninerviae, acutae. *Tepala* plerumque trinervia (3 nervis viridibus , ad apicem convergentia, lanceolata, 3 4 mm. longa, extus longis pilis flavidis nervis obsidentibus tepala superantibus antice divergentibus perspicue obtecta. *Staminae* 5 ; filamenta glabra, basi connata, dilatata, ad apicem valde, ad basin modice attenuata ; antherae minimae. *Ovarium* ovoideum, etorosum, stylus post anthesin androcceum dimidia parte superans, stigma discoideum.

British Somaliland. Between Walwal and Waredere, 22 Nov. 1944, *Glover & Gilland* 396, Kew (type) & Amani. Nomen vernac. : Negat.

It is impossible to place this species in *Chionothrix*, because the flowers are not wrapped in tufts of hairs ; whilst the habit is that of the genus *Psilotrichum*. The panicles are axillary, but the branches of the plant do not carry a terminal coma of leaves. The flowers have striking yellowish hairs. This species is named after one of the joint collectors, Major P. E. Glover, M.B.E.

Sericocomopsis grisea *Suessenguth*, nov. spec.

Characteres plerique *Sericocomopsis hildebrandtii* Schinz in Engler, Bot. Jahrb. **21,** 184 (1895). Differt a *Ser. hildebrandtii* : *Folia* late ovata, ad 3 cm. longa, ad 1·9 cm. lata, rarius obovata, non tam dense pilosa, nodi basales pilorum igitur magis perspicui. *Inflorescentiae* non interruptae, ad 6 cm. longae, 2 cm. latae ; flores maiores, tepala (6–) 8 mm. longa, non albo-straminea, sed *grisea*, imprimis vetustiora ; pili tepalorum articulati ramulis minimis, sed conspicuis instructi. Planta pilis non stellatis tantum vestita.

Tanganyika Territory. Kiruru, Upare, Moshi, alt. 780 m., May 1927, *A. E. Haarer* 499, Kew (typus). Mondul Distr., Ardai Plains, c. 1500 m., 29 June 1945, *Greenway* 7502, Kew.

" A much branched shrubby perennial up to 4 ft. tall with glomerules of pale pink flowers. Locally common but scattered with *Sericocomopsis*

hildebrandtii in *Commiphora, Balanites glabra, Carissa edulis, Acacia spirocarpa* bushland on a rocky hill slope on a brown powdery loam of volcanic origin ". (Greenway in sched. 7502).

Sericocomopsis pallida (*S. Moore*) *Schinz* in Engl. Bot. Jahrb. **21,** 185 (1895).

var. **parviflora** *Suessenguth*, var. nov.

Folia minora quam in forma typica, ad 1·9 cm. longa, ad 1·2 cm. lata, supra in sicco non fusca sed albide stellato-tomentosa ; tomentum non solvens. *Ramuli novelli* ad c. 3 cm. ab apice tomentosi, partes inferiores albo-incanae nec tomentosae. *Flores* ut in typo.

British Somaliland. Protection Plot, Burao, 6 Oct. 1944, *Glover & Gilliland* 70. " Much branched intricate bush of 2 ft."—Nomen vernac. : Wanad.

A SINGLE-AWNED ARISTIDA FROM SOUTH-EAST TROPICAL AFRICA.

C. E. Hubbard.

Aristida diminuta (*Mez*) *C. E. Hubbard*, comb. nov.

Stipa diminuta Mez in Fedde, Repert. **17** : 208 (1921). Nyasaland (*Buchanan*).

Aristida cumingiana Trin. et Rupr. var. *reducta* Pilger in Notizbl. Bot. Gart. Berlin, **11** : 805 (March 1933). Tanganyika Territory (*Schlieben* 2468).

Aristida cumingiana Trin. et Rupr. var. *uniseta* Stent et Rattray in Proc. Rhod. Sci. Ass. **32** : 48 (May 1933). Southern Rhodesia (*Eyles* 4931, *Fitt* 165).

Tanganyika Territory : Kilwa District ; Mkonji, in dry woodland, c. 250 m., *Schlieben* 2468 !

Nyasaland : Fort Hill, Tanganyika Plateau, 1050–1200 m., *Whyte* ! Kasupe, forming societies in perennially waterlogged area, 750 m., *Wiehe* N138 ! Neighbourhood of Zomba, c. 900 m., *Cormack* 224 ! 444 ! Without precise locality, *Buchanan* 561 !

Northern Rhodesia : Choma, *Rogers* 8089 ! East of Kasitu, 1350 m., *Eyles* 2849 !

Southern Rhodesia : Salisbury, 1500 m., *Holmes in Herb. Eyles* 4931 ! Lomagundi ; Trelawney, *Fitt* 165 !

Portuguese East Africa : Mocuba District ; Namagoa, in damp ground, 60–120 m., *Faulkner* 17 !

A very slender branched annual, with tufted or solitary culms up to 30 cm. high, loose or somewhat contracted panicles 4–10 cm. long, purplish spikelets 2–3 mm. long, and single-awned lemmas. It is so similar in most respects to *A. cumingiana* Trin. et Rupr. that it has been treated usually as a variety of that species. The main difference is, however, so consistent, i.e. the non-development of the lateral awns (the single awn being 7–10 mm. long, whereas the central awn of *A. cumingiana* is only 5–7 mm. and the lateral awns 3–4·5 mm. in length), whilst its area of distribution is restricted to south-east tropical Africa, that it appears preferable to treat it as a distinct species. From the genus *Stipa*, to which it was referred by Mez, it may be readily distinguished by its ciliolate ligules, 3-nerved lemmas and the possession of 2 (not 3) lodicules.

CONTRIBUTIONS TO THE FLORA OF TROPICAL AMERICA : L.*

Dr. Ducke's collections of Diospyros in Amazonian Brazil.

N. Y. Sandwith.

Shortly after the outbreak of the late War, Dr. Adolfo Ducke sent me a consignment of specimens of *Diospyros* which represented his collections of this genus in Amazonian Brazil over a period of many years. Owing to the evacuation from Kew of the material of *Ebenaceae*, it was not possible to name these specimens until after the cessation of hostilities. Recently, however, I have been able to study them. As with all Dr. Ducke's material, this collection of *Diospyros* has proved of great interest : it includes specimens of five new species, and it seems worth while to enumerate all the gatherings under their respective names. I have included notes on three of Martius' species, and a discussion of an obscure species described by Raddi, of which I was recently able to examine the type material. For the generous loan of type specimens I am indebted to the authorities of the herbaria of Brussels, Munich, Florence and Pisa.

Following most recent students of the genus, such as Mildbraed and Bakhuizen van den Brink, I have not recognized *Maba* as a distinct genus, nor have I any confidence in the survival of Hiern's sections when the American species of *Diospyros* are revised. Until this is done, however, it is convenient to maintain them for the purpose of grouping species according to certain affinities. No satisfactory understanding of American species of *Diospyros* will be reached until the inflorescences of both sexes of each species have been collected and duly related to each other and to fruiting collections.

In the citation of specimens of species which are not new, *Herb. Jard. Bot. Rio de Janeiro* is abbreviated *H.J.B.R.*, and it should be understood that the collector of all such *H.J.B.R.* numbers was Dr. Ducke.

Diospyros (Sect. *Patonia*) **trombetensis** *Sandwith*, sp. nov. ; *D. lissocarpoidi* Sandw. affinis, foliis minus coriaceis basi haud cordatis nervis lateralibus patulis subrectis, staminibus 12 statim distinguitur.

Arbor parva, ramis elongatis, ramulis teretibus glabris tenuissime sulcatis. *Folia* oblonga vel oblongo-elliptica, apice late usque ad 1·5 cm. acuminata, basi obtusa vel fere rotundata, haud cordata, 24–31 cm. longa, 7·7–9·5 cm. lata, firme chartacea vel subcoriacea margine revoluto, nitidula, glabra, nervis primariis utroque costae latere circiter 13 angulo satis lato patulis subrectis tum marginem versus arcuato-anastomosantibus utrinque praesertim subtus tenuiter prominulis, costa supra canaliculato-impressa subtus valde prominente, rete venularum satis intricato sed sub lente tantum conspicuo ; petiolus crassus, rugulosus, glaber, 1–1·2 cm. longus. *Inflorescentia* mascula tantum visa, axillaris, multiflora, cymis ut in *D. lissocarpoide* congestis atque globum efformantibus sub floribus pilis pallide brunneis dense pubescentibus ; pedicelli brevissimi. *Calyx* extra parce adpresse pubescens ; tubus fere 2 mm. longus ; lobi deltoidei, acuti, 1·3–1·5 mm. longi, basi 2 mm. lati. *Corolla* viridis, tota 1 cm. longa, extra glabra vel apice tubi parce obscure adpresse pubescens ;

*Continued from K.B. 1949, p. 264.

tubus cylindricus, 6 mm. longus, 3 mm. latus ; limbus ampliatus, lobis valde involutis atque contortis 4 mm. longis ad 3 mm. latis. *Stamina* 12, basi corollae inserta ibique plus minusve connata ; filamenta glabra, tenuia, inaequalia, 1·3—2 mm. longa ; antherarum loculi glabri, inaequales, 2 2·75 mm. longi, connectivo inter loculos adpresse piloso apice in appendicem lanceolatam glabram 0·5 mm. longam producto. *Ovarium rudimentarium* pilis flavo-brunneis hirsutum.

Brazil. Pará : lower Rio Trombetas ; Lago Salgado, in forest on high ground, Oct. 23rd 1919, *A. Ducke* in *Herb. Jard. Bot. Rio de Janeiro* 12613 (type in Kew Herb.) : small tree with elongated branches and green flowers.

This is evidently allied to *D. lissocarpoides* and, less closely, to *D. tetrandra* Hiern in the same section *Patonia*. A sheet (coll. *Martin*) of the male plant of the latter species was recently traced in material of another family in the Kew Herbarium, and shows that the inflorescence is few-flowered, as described and figured by Hiern, while the corolla is quite conspicuously pubescent on the outer surface, especially near the middle, characters which distinguish this species from both *D. lissocarpoides* and *D. trombetensis*.

Diospyros (Sect. *Paralia*) **santaremnensis** *Sandwith*, sp. nov. ; *D. tenuiflorae* A. C. Sm. affinis, foliis basi acute cuneatis reticulatione minus intricata minus prominula, inflorescentiis plurifloris, forma indumentoque calycis, corollae lobis duplo latioribus differt.

Arbor teste lectore magna, ramulis annotinis fere teretibus glabrescentibus hornotinis sub lente minute pubescentibus. *Folia* oblonga, apice late obtuse per 5–12 mm. acuminata, basi in petiolum acute cuneato-attenuata, 13–16 cm. longa (in ramulis hornotinis nonnunquam multo breviora), 4–5·3 cm. lata, tenuiter coriacea margine revoluto, supra nitidula glabra, subtus sub lente passim praecipue secus nervos minute sparse sed regulariter pubescentia, nervis primariis utroque costae latere 10–11 arcuato-ascendentibus margines versus conspicue anastomosantibus supra satis obscuris subtus conspicue prominulis, costa supra canaliculato-impressa subtus valde prominente, rete venularum haud valde intricato subtus tantum satis conspicuo ; petiolus rugulosus, minute pubescens, 6–8 mm. longus. *Inflorescentia* mascula tantum visa, axillaris, petiolum paullo superans, a basi ramosa, pluriflora, cymis multis congestis, pilis sordide albo-flavidis passim pubescens ; pedicelli 2–3 mm. longi. *Calyx* extra sparse obscure pubescens, intus albido-sericeus; tubus campanulatus, 2 mm. longus, ad 4·5 mm. latus; lobi late ovati, acuti vel obtusi, majores fere 3 mm. longi ad 3·2 mm. lati, minores alterni 2·5 mm. longi 2 mm. lati. *Corolla* alabastro 1·2 cm. longa ; tubus albus, ellipsoideo-urceolatus, floris plane aperti 9–10 mm. longus, 5·5–7 mm. latus, extra dimidio inferiore glaber superiore adpresse pubescens, intus glaber ; lobi virides, late ovati, apice rotundato-obtusi, basi truncato-subcordati vel etiam cordatuli, floris aperti 4·5–5·5 mm. longi atque lati, crassi, carnosi, demum reflexi, extra secus medium minute pubescentes, intus glabri. *Stamina* 12–13, inaequalia, basi corollae tubi inserta et in turmis bi-, tri- vel quadrijugis connata ; filamenta 1–2 mm. longa, glabra ; antherae 1·5–2 mm. longae, connectivo inter loculos adpresse piloso apice in appendicem anguste lanceolatam glabram ad 0·5 mm. longam producto. *Ovarium rudimentarium* dense flavido-hirsutum.

Brazil. Pará : Serra de Santarem, in forest on hills at Piquiatuba, Jan. 30th 1933, *A. Ducke* in *Herb. Jard. Bot. Rio de Janeiro* 25528 (type in Kew Herb.) : large tree with white flowers and green corolla lobes.

This appears to be a very distinct species, nearest within this section to *D. tenuiflora*, whose affinities with *D. tessmannii* Mildbr. and *D. guianensis* (Aubl.) Gürke were discussed by its author.

D. (*Paralea*) **guianensis** (*Aubl.*) *Gürke*. *D. paralea* Steud. ; Hiern, Mon. Ebenaceae, 240 (1873).

Pará : Faro, in forest bordering Campos do Tigre, Dec. 31st 1919, *H.J.B.R.* 12615, small tree with greenish yellow flowers ; Belem do Pará, at Agua Preta, on the margin of " igapó ", Nov. 13th 1926, *H.J.B.R.* 22285, small tree with brownish yellow flowers.

D. (*Rospidios*) **melinoni** (*Hiern*) *A. C. Sm.* in Bull Torr. Bot. Club, **60,** 390 (1933) ; Sandwith in Kew Bull. 1948, 320.—*Maba melinoni* (sphalm. *mellinoni*) Hiern, l.c. 143.

Pará : Belem do Pará, cultivated in the Museum garden, originally brought from a locality in the neighbourhood by J. Huber, ♀ fl. and fr. Aug. 1922, *H.J.B.R.* 22310 (=*Ducke* 273, 1st Coll.), ♀ fl. Aug. 23rd 1944, *Ducke* 273, 2nd Coll., a small tree with white flowers ; Peixeboi, by the railway between Belem do Pará and Bragança, in forest on *terra firma*, fr. March 24th 1927, *H.J.B.R.* 22309, a small tree with ripe fruit yellow and sweet ; Obidos, in forest on high ground towards Curuçambá, ♂ fls. Oct. 30th 1919, *H.J.B.R.* 12616, a small tree with whitish flowers ; Rio Tapajoz, at Villa Braga below the lowest falls, in forest on *terra firma*, ♀ fls. Oct. 14th 1922, *H.J.B.R.* 22304, a small tree with white flowers. The last collection is a form with more densely subsericeous-pilose calyces.

This is a well-marked species with a wide distribution, from Guiana to Matto Grosso, where it was collected in 1931 by *Krukoff* (no. 1402, distributed as " *D. pseudoxylopia* Mildbr. vel. valde aff.").

Diospyros (sect. *Rospidios*) **praetermissa** *Sandwith*, sp. nov. ; *D. sericeae* DC. affinis, indumento multo minus denso magis griseo, forma fructus statim distinguitur.

Arbor parva vel magna, ramulis annotinis glabrescentibus siccitate nigrescentibus, hornotinis tenuibus pilis griseis adpressis vel subadpressis dense pubescentibus. *Folia* lanceolata vel elliptico-lanceolata, apice conspicue (saepe 1 cm. vel ultra) acuminata, basi cuneata, 4–7·5 cm. longa, 1–2·6 cm. lata, firme chartacea vel subcoriacea, supra siccitate plumbea vel nigrescentia costa flavido-pubescente excepta glabra, subtus pilis parvis adpressis plus minusve griseo-sericea, costa supra impressa subtus prominente, nervis ceteris utrinque obscuris praesertim supra impressis, primariis utroque costae latere circiter 12 patule ascendentibus longe a margine anastomosantibus reticulatione laxa subtus intricatiore sed saepe haud obvia connexis, pagina superiore saepius verruculosa ; petiolus vulgo 3 mm. longus, dense adpresse vel subadpresse pubescens. *Flores* ♂ cymosi, complures fasciculati, pedicellis brevissimis ; calyx velut inflorescentia extra adpresse pubescens intus albido-sericeus, irregulariter lobatus atque fissus, tubo 5 mm.

longo, lobis deltoideo-ovatis acutis 1·75–3·5 mm. longis 1·75–3 mm. latis ; corollae tubus extra dense sericeo-pilosus intus glaber 4–4·5 mm. longus, lobi oblique obovato-oblongi 7 8 mm. longi 3–4·5 mm. lati extra secus medium dense adpresse flavicanti-pilosi praeterea pube minuta sericea sub pilis induti intus glabri ; stamina paulo supra tubi basin inserta, 60–65, inaequalia, filamentis plus minusve connatis 1–2·5 mm. longis, antheris 3–5 mm. longis adpresse pilosis. *Flores* ♀ saepius solitarii, demum penduli, pedicellis 3 4 mm. longis dense pubescentibus ; calyx extra dense minute flavicanti-pubescens intus sericeo-pubescens, tubo 4–5 mm. longo, lobis ovato-lanceolatis vel ovatis 4–5 mm. longis 3·5 mm. latis ; corollae tubus 2–3 mm. longus extra dense flavicanti-sericeo-pilosus, lobi oblique obovato-oblongi 0·9–1 cm. longi ad 5·75 mm. lati extra vitta mediana sericeo-pilosa inferne latiore praediti praeterea latere dextro angustiore minute pubescente ; staminodia pauca circiter 9–12, 3–3·5 mm. longa, pilosula ; ovarium 6-loculare loculis 1-ovulatis, ovoideo-subglobosum, pilis flavidis erectis rigidis dense tomentosum. *Fructus* junior ovoideus dense sericeo-pubescens pilis longioribus immixtis, apice obscure umbonatus tantum nec ut in *D. sericea* in apicem conicum conspicuum contractus, maturus globosus 3–3·5 cm. diametro valde rugulosus jugis rugularum glabris siccitate nigrescentibus demum omnino glabrescens.

Brazil. Amazonas : Manáos, silva terris altis ultra Coloniam João Alfredo, arbor magna floribus albis, ♀ fl. May 7th 1936, fr. Dec. 1936, *A. Ducke* in *Herb. Jard. Bot. Rio de Janeiro* 35542 (=*Ducke* 546), type in Kew Herb.

Pará : Bragança, Colonia Benjamim, in silva secundaria vetustiore loco alto, arbor parva, fructibus maturis luteis, ♀ fl. Jan. 11th 1923, *H.J.B.R.* 22305 ; Bragança, silva non inundabili, arbor parva floribus albidis, ♂ fl. Feb. 8th 1923, *H.J.B.R.* 22306 ; Serra de Santarem, loco Piquiatuba in silva collina, arbor ultra 30 m. alta trunci diametro ultra 1 m., floribus viridi-albidis, ♂ fl. May 16th 1927, *H.J.B.R.* 22288 ; Rio Tapajoz, in silva terris altis ad cataractam Poção, arbor vix mediocris floribus albidis, ♂ fl. Dec. 23rd 1919, *H.J.B.R.* 12614.

The following collection, with rather larger leaves more rounded at the base, and a less sericeous indumentum of longer looser hairs on the lower surface, is probably referable to this species : Pará ; Juruty Velho, in silva terris altis ultra lacum, arbor 30 m. alta, fr. May 27th 1927, *H.J.B.R.* 22287.

This species of Amazonian Brazil is evidently related to *D. sericea* DC. (*Maba sericea* (DC.) Hiern), a species of Bahia, Goyaz and Minas Geraes, which differs in the denser, more sericeous and yellowish indumentum of longer hairs on the branchlets, lower leaf surface, pedicels and calyx, and in the conspicuous abruptly conical apex of the fruit. I have not seen the specimen collected by Riedel at Borba, on the Rio Madeira, which Martius cited under *D. apeibocarpos* Raddi, when reducing that species to *D. sericea* (see my notes on *D. apeibocarpos*), but think it is probable that it will prove to be referable either to *D. praetermissa* or to *D. pseudoxylopia* Mildbr., a related species of the upper Amazons, which has leaves very densely yellowish-sericeous beneath and male flowers with very few stamens. *D. praetermissa* differs from the four Rio de Janeiro

collections discussed below under *D. apeibocarpos*, and referred to a new species in this paper, in the shape and indumentum of the leaves, the shorter petioles, the longer tube and shorter lobes of the calyx of the flowers of each sex, and the indumentum of the corolla.

Diospyros (*Rospidios*) **apeibocarpos** ("*Apeibacarpos*") *Raddi*, Memoria in Atti Soc. Ital. Sci. Modena, **18,** 12 (1820) ; DC. Prodr. **8,** 239 (1844) ; Miq. in Mart. Fl. Bras. **7,** 4, in obs. (1856) ; Mart. l.c. 8, in obs. ; Hiern, l.c. 269.

This Brazilian species was treated as *non satis nota* by De Candolle, and as *incognita* by Miquel in his account of *Ebenaceae* for the *Flora Brasiliensis*. Martius, the editor of the latter, who added several supplementary descriptions of new species to Miquel's account, gave his own opinion on the identity of *D. apeibocarpos* in a special note. He regarded it as synonymous with the later name *D. sericea* DC., gave a short Latin description of the fruit and seeds adapted from Raddi's Italian, and commented on the wide area of distribution resulting from the union of the two species and from the citation of two further localities from Minas Geraes (coll. Martius) and from Borba on the Rio Madeira (coll. Riedel). Hiern placed *D. apeibocarpos* among the imperfectly known species at the end of his monograph and, commenting on Martius' identification of it with *D. sericea*, remarked, "But the fruit appears to be different". Since that date a collection of *Diospyros* made in the neighbourhood of Rio de Janeiro and determined as *D. apeibocarpa* [*sic*] Raddi by J. G. Kuhlmann has been distributed from Rio de Janeiro under the number *H.J.B.R.* 507.

There is no evidence that any of the above-mentioned writers ever examined the type material of Raddi's species, which he said was a very rare one, found by him on a single occasion on the Serra da Estrella, near Rio de Janeiro in the state of that name. This material has now been lent to me by the Herbarium of the Botanic Garden at Pisa, through the kind mediation of Prof. R. Pichi-Sermolli, of Florence. Unfortunately, it is fragmentary, consisting of a single leafless branchlet on the sheet itself, and of 4 leaves and broken portions of a fruit in an envelope attached to the sheet. This being so, there is perhaps little of significance that can be added to Raddi's description, but the details are important for the correct interpretation of the species by future collectors near Rio de Janeiro.

The apex of the slender branchlet and the bases of the petioles and pedicels are densely villous with yellowish brown hairs of varying length, the longest being 1·5 mm. The leaves, which are of different age, are narrowly lanceolate or oblong-lanceolate, 7·8–9·4 cm. long, 1·7–2·4 cm. broad, either distinctly acuminate or merely acute at the apex, more or less rounded at the base, the margins distinctly revolute, usually conspicuously so towards the base. The youngest of the four leaves is copiously pubescent with short hairs all over the upper surface and the midrib is densely villous with longer, yellowish brown hairs. The next older leaf has a similar indumentum on the midrib above, but the short hairs of the surface are almost confined to the main lateral nerves. In the third leaf the upper surface is glabrous except for the midrib which is pubescent (especially towards the base) with short hairs, the longer ones

having fallen. The fourth leaf is much more coriaceous than the others, being almosy bullate on the upper surface and with the margins strongly revolute in the lower third ; the upper surface is glabrous except for the midrib which is pubescent with short hairs. All the leaves have dried a blackish colour on the upper surface, and this surface is intricately rugulose on the three younger leaves and distinctly verruculose on the oldest one. The midrib is canaliculate, and the rest of the nerves are impressed and very inconspicuous, except on the oldest leaf, where the venation is evident though not raised nor conspicuous. The lower surface of all the leaves is clothed with very numerous, soft, straw-coloured hairs of varying length, most of them being more than 0·5 mm. and less than 1·5 mm. long. There is no question of an adpressed sericeous tomentum. The hairs are quite loosely set, and are ascending, with the surface plainly visible beneath them. As remarked by Raddi, they are particularly dense and conspicuous on the midrib and margins, and especially long and spreading on the midrib. The lateral nerves are inconspicuously evident and scarcely prominulous ; they are 10–12 on each side of the midrib, ascending (the lower ones often at rather wide angles), and anastomosing at a long distance from the margin. The petioles are 2·5–4·5 mm. long, those of the two younger leaves clothed with very dense, spreading, yellowish brown hairs, those of the old leaves irregularly pubescent with shorter, less conspicuous hairs. The fruiting calyx is about 1 cm. across, the lobes densely clothed in the lower half with yellowish brown hairs, otherwise black and glabrescent in the dried state : they seem to have been comparatively short and rather broadly ovate, quite unlike the narrowly triangular-ovate calyx-lobes of *D. sericea*. The fruit itself was apparently 1 inch in diameter, depressed-globose, and lacking the abruptly conical apex which is such a characteristic feature of that of *D. sericea*. The surface is rough and rugulose-warty all over, and is copiously clothed with straw-coloured or yellowish brown hairs of many lengths but mostly short, those over 0·75 mm. having for the most part fallen except near the apex and base. A detached seed is 1·3 cm. long, 9 mm. broad, black and glabrous.

It is evident that *D. apeibocarpos*, though doubtless a member of the section *Rospidios*, cannot possibly be regarded as conspecific with *D. sericea*, a species occurring in Bahia, Goyaz and Minas Geraes, from which it differs in indumentum, relatively longer leaves, calyx lobes and fruit. It is nearer to the Rio de Janeiro tree which has been collected and related to it by Kuhlmann (*H.J.B.R.* 507) and by Freire Allemão (see a specimen in Herb. Mus. Brit.), and with which *Glaziou* 10227 and 14058, from districts of Minas Geraes close to Rio, are certainly conspecific although they were referred to *D. sericea* in Glaziou's *Liste* in *Bull. Soc. Bot. France, Mém.* **3** d, 442 (1909). But the leaves of these four collections, which hang so well together and are wholly distinct from *D. sericea* in leaves and fruit, do not agree at all well with those of *D. apeibocarpos* : they are more elliptic or elliptic-lanceolate in outline, and the pubescence of the lower surface is much shorter and more adpressed, while the hairs on the midrib are all directed forwards. The fruit of *H.J.B.R.* 507 is 1½ inches in diameter and therefore much larger than that of the type material of *D. apeibocarpos*, but it is conceivable that the latter had not reached maturity. These four collections, in fact, apparently represent a new species, which is described below under the name

D. janeirensis. On the other hand, the indumentum of the leaves of Raddi's type of *D. apeibocarpos* is extremely similar to that of *D. gaultheriifolia* Mart., a species of the states of Bahia and Alagoas, which has much broader leaves which are rounded and slightly cordate at the base,while the old fruits have a rugulose-warty surface which is glabrous except for scattered hairs of the long type. It seems very likely that the true affinity of *D. apeibocarpos* will prove to be with *D. gaultheriifolia*. Meanwhile, it is much to be hoped that further individuals of Raddi's tree will be discovered on the Serra da Estrella, so that flowers and fruit can be correlated with the leaf characters of his fragments.

The first constituent of Raddi's specific epithet, which he spelled *Apeibacarpos*, was derived from Aublet's generic name *Apeiba* on account of the resemblance of the fruit. This, in its turn, was an adoption of *Apeiba* Marcgrav. Hist. Rar. Nat. Bras. **3,** 123 (1648), a Brazilian vernacular name. In order to avoid the creation of a mongrel, the connecting vowel o, rather than i, has been chosen by the present writer, to precede the second, Greek, constituent of Raddi's name, which is accordingly spelled *apeibocarpos*.

Diospyros (Sect. *Rospidios*) **janeirensis** *Sandwith*, sp. nov. ; *D. praetermissae* Sandwith ut videtur affinis, forma indumentoque foliorum, petiolis longioribus, lobis calycinis longioribus, indumento corollae differt.

Arbor parva, ramulis superioribus gracilibus glabrescentibus, ultimis hornotinis dense minute flavescenti-puberulis atque pilis longioribus prorsus directis vel patule ascendentibus indutis ; internodia 1–2 cm. longa. *Folia* anguste elliptica vel elliptico-lanceolata, ima minora nonnunquam obovato-elliptica apice rotundata, cetera ad apicem obtusum vel acutum attenuata, raro plus minusve acuminata, basi in petiolum acute cuneato-attenuata, (2·8) 5–8 cm. longa, 1·2–2·5 cm. lata, coriacea marginibus revolutis piloso-ciliatis vel glabratis, supra siccitate plumbea costa primo dense pubescente demum glabrescente excepta glabra, subtus siccitate brunneo-purpurascentia pilis parvis inaequalibus adpressis regulariter copiose sparsis secus costam densioribus prorsus directis pubescentia, costa supra canaliculato-impressa subtus prominente, nervis ceteris impressis vix distinguendis, pagina superiore plus minusve crebre rugulosa ; petiolus 4–7 mm. longus, indumento ramulorum praeditus. *Flores* ♂ complures fasciculati, pedicellis ad 5 mm. longis ; calyx velut inflorescentia ramulique juniores extra pubescens atque pilosus demum ruguloso-verruculosus intus griseo-tomentosus, tubo 3 mm. longo, lobis triangulari-lanceolatis 4 mm. longis 3 mm. latis ; corollae tubus nisi sub mediis lobis glabrescens, 3 mm. longus, lobi oblique obovato-oblongi 8 mm. longi 4–6 mm. lati extra dimidio inferiore prope atque secus medium flavicanti-pilosi et minute puberuli ceterum glabri nisi prope apicem praesertim secus marginem furfuraceo-puberuli ; stamina plus quam 100 (an semper ?), prope corollae tubi basin inserta, filamentis varie connatis 1–1·5 mm. longis setoso-pilosis, antheris inaequalibus 4–5 mm. longis satis rigide setoso-pilosis atque plerumque apice setiferis. *Flores* ♀ (e *Glaziou* 14058) pedicellis nutantibus indumento supra descripto ; calyx indumento simili sed tubo 2 mm. longo intus glabro, lobis 5–8 mm. longis 3–3·5 mm. latis ; corollae tubus circiter 2 mm. longus vittis medianis flavo-pilosis de lobis descendentibus

ceterum glaber, lobis circiter 8 mm. longis (junioribus tantum visis) dimidio inferiore tantum secus vittas medianas flavo-pilosis ceterum glabris ; staminodia minus quam 10, 2–3 mm. longa, pilosa ; ovarium 6-loculare loculis 1-ovulatis, pilis brunneo-rufescentibus dense villoso-tomentosum. *Fructus* globosus, apice depresso-umbonatus tantum, unicus visus 4 cm. diametro, crebre rugulosus, minute tomentellus, pilis longioribus nisi apice atque prope basin plerisque delapsis.

Brazil. Rio de Janeiro : Rio de Janeiro, ad urbem loco Mundo Novo, arbor parva, ♂ fls., fr., Nov. 10th 1920, *J. G. Kuhlmann* in *Herb. Jard. Bot. Rio de Janeiro* 507 (type in Kew Herb.). " Arbre des fôrets de Rio de Janeiro ", ♀ fls., coll. *Fr. Allemão*, in Herb. John Miers bequeathed 1879 (Herb. Mus. Brit.) : this specimen was given the manuscript name of an unpublished new species by Allemão, and was also identified as " an *D. apeibacarpus* ? "

Minas Geraes : localities near Rio de Janeiro (Barbacena, Queluz, Serra do Cipó), *Glaziou* 10227, 14058 (Herb. Kew.).

The relationship of this species to *D. apeibocarpos* Raddi, to which the type material was referred by Kuhlmann, is discussed in the note on that species. The Glaziou specimens were incorrectly referred to *D. sericea*. The nearest affinity of *D. janeirensis* seems, on present evidence, to be with *D. praetermissa*, see the notes following the description of that species.

Diospyros (Sect. *Rospidios* ?) **duckei** *Sandwith*, sp. nov. ; ab omnibus speciebus austroamericanis staminibus uno excepto medio corollae tubo insertis differt, verosimiliter in sect. *Rospidios* prope *D. subrotatam* Hiern ponenda a qua foliis chartaceis inflorescentia magis condensata praesertim forma corollae minime subrotata statim distinguitur.

Arbor parva vel satis magna, ramulis hornotinis copiose adpresse pubescentibus annotinis glabratis. *Folia* elliptica vel elliptico-oblonga, apice anguste conspicue per 0·5–1·5 cm. acuminata, basi in petiolum acute cuneato-attenuata vel in foliis latioribus obtusa, 5–15·5 cm. longa, 2–6·5 cm. lata, chartacea, supra costa flavido-pubescente excepta (hac etiam senectute glabrata) glabra siccitate plumbea, subtus passim haud dense sed regulariter adpresse pubescentia siccitate rubro-brunnea, nervis primariis utroque costae latere 10–12 subrecte patulis vel patulo-ascendentibus satis longe a margine anastomosantibus supra impressis obscuris subtus tenuiter tantum prominulis, costa supra canaliculato-impressa subtus prominente, rete venularum satis laxo subtus sub lente tantum satis prominulo, pagina superiore creberrime minute verruculoso-rugulosa inferiore crebre punctulata ; petiolus vulgo 5–6 mm. longus, supra canaliculatus, adpresse pubescens. *Inflorescentia* mascula tantum visa, axillaris, e floribus nunc paucis nunc multis in fasciculum arcte congestis constans, ubique pilis flavido-brunneis sericeo-pubescens ; bracteae conspicuae, deciduae, majores orbiculari-ovatae, obtusae, 3·2–5 mm. longae, 3·2–4 mm. latae, costa extra conspicua cariniformi, extra hic illic sub lente nigro-punctatae ; bracteolae angustiores. *Flores* albi. *Calyx* extra dense adpresse subsericeo-pubescens ; tubus campanulatus, 4–5 mm. longus, 5–6 mm. latus, intus dimidio inferiore parce sericeus vel glaber superiore sericeus ; lobi 4–5, deltoideo-ovati, acuti, 1·2–3 mm. longi, basi circiter 2–3 mm. lati, intus sericei atque patulo-puberuli. *Corollae* tubus plus minusve cylindrico-infundibuliformis,

sursum sensim ampliatus, 8 mm. longus, 4–5 mm. latus, extra sericeus, intus glaber ; lobi 4, inaequales, demum plus minusve patulo-recurvi, elliptico-oblongi vel oblique obovato-oblongi, apice breviter late obtuse acuminati, 6–7 mm. longi, 1·75 4 mm. lati, crassi, carnosi, marginibus involutis, extra secus medium pilis sordide albo-flavidis late sericeo-vittati intus glabri. *Stamina* 21 -23, inaequalia, in turnis quatuor basi connata, medio corollae tubo inserta, excepto singulo inferius inserto ; filamenta brevissima, pilosa; antherae 3 6 mm. longae, ex ore floris aperti exsertae, adpresse pilosae, pilis flavidis longioribus usque ad 1·5 mm. longis, connectivo apice in appendicem triangulari-lanceolatam ad 0·5 mm. longam glabram producto. *Ovarium rudimentarium* dense adpresse flavido-pilosum.

Brazil. Pará : Rio Tapajos, at Montanhinha, in forest on high ground, Oct. 6th 1922, *A. Ducke* in *Herb. Jard. Bot. Rio de Janeiro* 22290 (type in Kew Herb.), a small tree with white flowers ; Juruty Velho, in forest on high ground beyond the lake, Dec. 20th 1926, *H.J.B.R.* 22284, a fairly large tree with white flowers.

Owing to the unusual character of the insertion of the stamens in 4 groups at the middle of the corolla tube (an additional stamen being free and inserted lower than the others) this outstanding species of the Tapajoz river region would have been placed by Hiern in his small section *Cunalonia*. This was made up of two species, *D. dendo* Welw. ex Hiern, of Angola, and *D. ? cunalon* DC., of the Philippine Islands. The latter was based on a plant imperfectly described by Blanco and was treated by Merrill as a species of uncertain status, see " Species Blancoanae ", 304 (1918) and Enum. Philipp. Fl. Plants, **3,** 296 (1923). Blanco's " Cunalon " had a corolla with 8 stamens, 4 inserted at the base, and 4 in the middle of the lobes, and is unlikely to belong to this genus. The Angolan *D. dendo* is completely distinct from *D. duckei* on account of its deeply divided calyx and small glabrous 5-6-lobed corolla ; besides, its 20 or 24 stamens are inserted by pairs alternately opposite to and alternate with the corolla lobes, whereas the stamens of *D. duckei* are arranged in 4 groups which are opposite the 4 corolla lobes. It is clear that the insertion of the stamens midway in the corolla tube instead of at the base, although exceptional, is not in itself enough to constitute a distinct section.

In spite of the shape of the corolla, with its conspicuous silky cylindric-funnelshaped tube, *D. duckei* seems best placed in Hiern's section *Rospidios*, on account of the indumentum, the verrucular upper surface and general facies of the foliage, as well as the calyx and the exserted anthers. Within this group it seems most nearly allied to *D. subrotata* Hiern and *D. amazonica* Krause, which in the writer's opinion are likely to prove conspecific.

D. (*Rospidios*) **subrotata** *Hiern*, l.c. 250.

Pará : Rio Anajaz, on the island of Marajó, west side, on the flooded bank of a stream, Nov. 24th 1922, *H.J.B.R.* 22299. Small tree with greenish white flowers.

D. (*Rospidios*) **amazonica** *Krause* in Verh. Bot. Ver. Brandenb. **48,** 193 (1907).

Amazonas : lower Rio Javary, Remate de Males, in forest subject to periodic flooding, Nov. 1st 1927, *H.J.B.R.* 22286, small tree with white flowers ; Tabatinga, in forest on swampy bank of stream, Dec. 2nd 1945, *Ducke* 1885, small tree with white flowers.

This is very doubtfully separable from *D. subrotata* Hiern, of which it appears to be a form with thicker leaves, more glabrous and verrucular on the lower surface, and with the hairy bands on the corolla not extending so far up the lobes and therefore often scarcely evident until the calyx is removed. Apparently intermediate forms occur, in which these characters of leaves and corollas are not found in correlation.

D. (*Rospidios*) **polyandra** *Spruce ex Hiern*, l.c. 251.

Amazonas : Rio Negro ; Cucuhy, on flooded river-bank, Sept. 18th 1935, *H.J.B.R.* 37466. Small tree with white flowers.

D. guatterioides A. C. Sm. in Brittonia, **2,** 162 (1936), is perhaps conspecific.

D. (*Rospidios*) **longistyla** *A. C. Sm.* in Brittonia, **2,** 161 (1936).

Pará : Rio Tapajos, near the middle of its course at Montanhinha, in forest (palmetum " uauassúa ") on high ground, ♂ fls. Oct. 6th. 1922, *H.J.B.R.* 22307. Small tree with white flowers.

The type collection of this species bore ♀ inflorescences. The description may thus be completed from Dr. Ducke's specimen, as follows : ♂ inflorescence similar to the ♀ and with the same indumentum ; calyx deeply divided into 6 lobes which are deltoid-ovate, 5–6 mm. long, 4–4·75 mm. broad, subsericeous-tomentose on the inner surface; corolla about 1·2 cm. long, deeply divided into 6–7 lobes which are oblong, rounded at the apex, 5·5–7 mm. broad, glabrous except for a median dorsal band of dense yellowish-brown hairs ; stamens 42 in the single flower which was dissected, connately inserted at the base of the corolla, unequal, the filaments short, thick and pilose, the anthers up to 5 mm. long, pilose, the connective produced at the apex into a short, blunt, glabrous appendage ; rudimentary ovary absent.

D. (*Rospidios*) **bullata** *A. C. Sm.* in Journ. Arnold Arb. **20,** 302 (1939).

Amazonas : Manáos, at Estrada do Aleixõ in forest on *terra firma*, ♂ fls. Dec. 13th 1932, *H.J.B.R.* 25526 (*Ducke* 366), ♀ fls. Dec. 9th 1932, *H.J.B.R.* 25527 ; Manáos, beyond Flores, in forest on *terra firma*, ♀ fls. Dec. 17th 1936, *Ducke* 360. According to Ducke, this is a shrub or small tree with long, pendent, verticillate, apical branches, and fragrant white corollas which are sometimes pink within.

Ducke 360 and 366 were used by A. C. Smith for his description of the flowers of this species.

D. (*Rospidios*) **krukovii** *A. C. Sm.* in Bull. Torr. Bot. Club. **60,** 390 (1933).

Amazonas : Rio Solimões ; Foz do Jutahy, in forest not subject to flooding, Nov. 19th 1927, *H.J.B.R.* 21569. Shrub with white flowers.

The leaves are a perfect match with those of the type collection, *Krukoff* 1564, but the inflorescence consists of crowded, small male flowers, remarkably different from the solitary and quite large flower of the type.

It is evident that *D. krukovii* by no means always has the flowers perfect, as was suggested by its author. The male flowers may be described as follows : ♂ inflorescence axillary, composed of numerous, densely congested small flowers covered with a dense subsericeous-pilose pale brown indumentum ; calyx deeply 3–5-lobed, the lobes ovate or ovate-lanceolate, 1–1·5 mm. long, 0·75–1·3 mm. broad, densely pilose outside, glabrous within ; corolla ovoid-oblong, only 3–3·75 mm. long and 1·75–2·5 mm. broad, deeply divided towards the base into 3–5 ovate obtuse lobes up to 2·2 mm. broad with broad bands of sericeous pubescence on the back ; stamens 12–15, connate at the base of the corolla, the filaments very short and glabrous, the anthers 1·5–2·5 mm. long, pilose, their connective produced into a short glabrous appendage.

Diospyros Sect. *Rospidios* **micrantha** *Sandwith*, sp. nov. ; ob habitum, formam foliorum, flores masculos minimos congestos insignis, *D. myristicoidi* Hiern Macbr. atque *D. gaultheriifoliae* Mart. forsan affinis, ab illa indumento fulvo longiore foliis minoribus basi rotundatis floribus haud trimeris, ab hac foliis nec coriaceis sub-bullatis nec basi cordatulis lobis calycinis angustioribus corollis extra conspicue vittato-pilosis staminibus paucis differt ; *D. peruviana* Hiern floribus multo majoribus staminibus numerosioribus facile distinguitur.

Arbuscula ; rami terminales verticillati horizontales flagelliformes, indumento piloso sublanato uno latere detersili praediti, superpositis pilis longioribus fulvis crebris ascendentibus juventute nitidulis. *Folia* subsessilia, conspicue disticha, lanceolata vel anguste oblongo-lanceolata, in apicem mucronatum sensim angustata, basi rotundata, prope medium ramulum 8–10 cm. longa, 1·8–2·5 cm. lata, utrinque praesertim basin versus sensim minora, chartacea, utrinque punctato-verruculosa, supra costa dense pilosa excepta glabra, subtus pilis satis longis subadpressis crebre pilosa praeterea costa dense villosa, nervis lateralibus utrinque obscuris supra impressis subtus tenuissime prominulis patulo-ascendentibus atque longe a margine anastomosantibus ; petiolus brevissimus, vix ad 1·5 mm. longus, dense fulvo-pilosus. *Inflorescentia* mascula tantum visa. *Flores* pro genere minimi, ochroleuci, in fasciculum axillarem parvum ubique fulvo-pilosum aggregati ; bracteae lanceolato-ovatae, acuminatae, 3·2 mm. longae, circiter 1·5 mm. latae ; bracteolae minores. *Calyx* profunde fissus in lobos 4–5 lanceolatos 1–1·6 mm. longos 0·5–0·75 mm. latos extra fulvo-pilosos intus superne pilosos verruculoso-glandulosos. *Corolla* ovoideo-urceolata, tota 2·75–3 mm. longa, 1·5–1·75 mm. lata, usque ad dimidium vel ultra in lobos 4–5 ovato-acuminatos circiter 1·2 mm. latos divisa, extra basi glabra ceterum secus medios lobos atque deorsum late vittato-pilosa, intus glabra. *Stamina* 10–14 basi corollae inserta atque plus minusve connata, filamentis brevissimis ; antherae longe pilosae, circiter 1·5 mm. longae, connectivo apice in appendicem anguste deltoideo-lanceolatam apice obtusam glabram producto. *Ovarium rudimentarium* nullum. *Fructus* unicus visus ovoideo-subglobosus, circiter 1·8 cm. longus, 1·5 cm. diametro, dense longe fulvo-villosus, praeterea pagina ipsa breviter adpresse pubescente rugosa ; lobi calycini sub fructu elongati, anguste lanceolati, circiter 1 cm. longi atque 2 mm. lati.

Brazil. Amazonas : Rio Solimões, São Paulo de Olivença, in forest in sandy " catinga ", ♂ fls. Nov. 21st 1940, *A. Ducke* 635 (type in Kew

Herb.); *ibid.*, fr. Jan. 27th 1937, *Ducke* in *Herb. Jard. Bot. Rio de Janeiro* 37465.

A very distinct species on account of the long fulvous hairs, the narrow distichous leaves resembling those of a species of *Xylopia*, and the very small crowded male flowers with calyces deeply divided into narrow lobes. Only a single fruit is present on the second collection.

D. (*Rospidios*) **myristicoides** (*Hiern*) *Macbr.* in Candollea, **6,** 18 (1934).—*Maba myristicoides* Hiern, l.c. 142.

Amazonas : Rio Negro ; above mouth of R. Curicuriary, in " catinga" forest, Dec. 15th 1931, *H.J.B.R.* 25529. Small tree with white flowers.

A very local species, previously collected by Spruce in " catinga " on the Rio Uaupés. Remarkable on account of the very small male flowers.

D. (*Rospidios*) **myrmecocarpa** *Mart.* in Mart. Fl. Bras. **7,** 7 (1856). —*Maba myrmecocarpa* (Mart.) Hiern, l.c. 141.

I have examined two sheets of Martius' type gathering from the Rio Japurá, Brazil, which were kindly lent to me by the authorities of the Munich Herbarium. The affinity with *D. myristicoides*, as indicated by Hiern, is obvious ; the branchlets and leaves of the two species, in fact, resemble each other so closely in most details that I have little doubt that further collections will prove them to be conspecific. At present *D. myrmecocarpa* is known only from a fruiting collection, while *D. myristicoides* has been twice collected, each time with male flowers. The localities of the three collections are all in the same region of Amazonia.

In his key Hiern distinguished *myrmecocarpa* from *myristicoides* by the character of the spreading hairs on the shoots, which Martius described in the phrase " ramulis patentim ferrugineo-hirtulis." One of the Martius sheets from Munich shows numerous, scattered, long (up to 2·5 mm.) spreading hairs along the single branchlet ; but these hairs are absent from the two branchlets of the other sheet, one of which actually has a number of adpressed or subadpressed hairs towards its apex. The material otherwise agrees perfectly, and in each case the branchlets show a copious, minute, scurfy indumentum such as can be seen on those of *D. myristicoides* in addition to the longer adpressed hairs characteristic of that species. Apart from this character, of very doubtful validity, the nerves and veinlets of each surface of the leaves of *D. myrmecocarpa* are less immersed in the rugulose-verruculose mesophyll than the corresponding veins of the leaves of *D. myristicoides*, so that the lower surface, in particular, appears less shagreened. Again, there seem to be far fewer hairs on the lower surface of the leaves of *D. myrmecocarpa*, the hairs being largely confined to the midrib and lateral nerves. I doubt very much if these differences have any specific or even varietal significance.

Krukoff 5653, a fruiting collection from the Rio Purus basin, which was identified by A. C. Smith as *Maba myrmecocarpa*, belongs to a wholly different species of *Diospyros* which I cannot yet identify.

D. (*Rospidios*) **artanthifolia** *Mart.* in Mart. Fl. Bras. **7,** 7 (1856) ; Hiern, l.c. 252.

The authentic sheet of *Poeppig* 2266 in Martius' herbarium was kindly lent to me by the authorities of the Brussels Herbarium. It consists of a branchlet with good leaves, and bears a single fruit, all exactly as described by Martius and Hiern, except that the calyx lobes are really

triangular-lanceolate and were probably acute (the apex is broken off from the only lobe which is visible).

From the evidence of the branchlet and foliage, this material is conspecific, in my opinion, with *D. pearcei* Hiern, l.c. 252, of Bolivia, the leaves and indumentum of which agree excellently with it. The type of *D. pearcei* bears good male inflorescences. *D. peruviana* Hiern var. *sprucei* Hiern, which from the evidence of the locality (Tarapoto) might be expected to be more nearly related to *D. artanthifolia*, collected by Poeppig at Maynas, differs from it in the much denser indumentum of the lower surface of the leaves, which is conspicuously warty-rugulose, and in the densely fulvous-tomentose calyx.

D. (*Cavanillea*) **poeppigiana** *DC.* ; Hiern, l.c. 256.

Pará : Rio Tapajoz, bank of the island Gayaua, below the lowest cataract, ♂ fls., Oct. 13th 1922, *H.J.B.R.* 22291, small tree with white flowers. Amazonas : Rio Negro, Santa Izabel, on flooded banks, ♀ fls., Dec. 8th 1929, *H.J.B.R.* 22303, small tree with white flowers.

This species probably includes the very closely related *D. emarginata* Hiern, a tall tree with obovate retuse leaves and more numerous stamens, once collected by Spruce on the Rio Negro between Manáos and Barcellos. Spruce noted that it grew always within inundated forest, whereas the more plentiful *D. poeppigiana* was a small tree on the skirt of such forest in the same locality. He regarded *D. emarginata* as quite distinct, but it is likely to be a habitat form of *D. poeppigiana*. The number of stamens is probably variable, since a flower of *H.J.B.R.* 22291, otherwise agreeing well with *D. poeppigiana*, was found to have about 40 stamens.

D. xylopioides *Mart.* in Mart. Fl. Bras. **7,** 8 (1856) ; Hiern, l.c. 269.

This was placed with doubt in *Diospyros* by both Martius and Hiern ; the latter, in fact, who saw the type, suggested that it was perhaps a new genus. The specimen in Martius' herbarium has recently been lent to me by the authorities of the Brussels Herbarium. The label reads as follows : " Diospyros xylopioides Mart. Guiana [in Lindley's hand]. Lindley dedit 1826 ". The true source of the specimen has thus not been previously revealed, since it appeared from Hiern's treatment of the species that it had been collected in Guiana by Martius himself, while the latter gave no collector's name and did not mention Lindley as the donor.

To my surprise, there is no doubt whatever as to the identity of this plant. It is not a *Diospyros*, but is certainly *Xylopia frutescens* Aubl., agreeing perfectly with this well-known Guiana species in all essential characters, including even the very young flower buds which can be matched with similar buds on a Kew specimen collected by Martin in French Guiana. It is, indeed, quite possible that Martius' material came from part of the Martin gathering which was in Lindley's possession and should now be sought in his herbarium at Cambridge University.

It is strange that Martius stressed the resemblance of his specimen to *Xylopia frutescens* without realising its identity. Hiern, on the other hand, was wide of the mark in saying that the foliage was " exceedingly like that of *Maba sericea* ". Fortunately, no name change is involved : *Diospyros xylopioides* Mart. becomes a synonym of *Xylopia frutescens* Aubl.

A NEW CASEARIA FROM ECUADOR.

N. Y. Sandwith.

Casearia mexiae *Sandwith*, sp. nov. ; Sect. *Pitumba*, staminibus 10 stigmate simplici globoso-capitato gaudens, ob flores magnos valde distincta.

Arbor parva ; ramuli glabri, annotini conspicue corrugati atque lenticellati. *Folia* elliptica, elliptico-oblonga vel ovata, apice obtusa vel nonnunquam plus minusve rotundata, basi obtusa vel subtruncata oblique plicatula latere altero evidentius in petiolum abrupte decurrente, 7·5–11 cm. longa, 4·3–7·3 cm. lata, tenuiter coriacea, regulariter crenato-dentata incisuris a sese vulgo 4–9 mm. remotis, supra glabra, subtus hic illic sparse pilosula vel glabrata, costa lata siccitate straminea supra fere plana subtus prominente, nervis primariis utroque costae latere 7–8 ascendentibus atque longe a margine anastomosantibus supra tenuissime prominulis subtus prominentibus, rete venularum laxo sed conspicuo praeterea areolis ultimis subtus conspicuis intricatissime reticulatis, venulis omnibus satis pellucidis, praeterea punctis lineolisque pellucidis more generis satis crebre sed haud dense praedita ; petiolus conduplicato-canaliculatus, glaber, 6–10 mm. longus. *Flores* secus ramulos annotinos defoliatos in glomerulis sessilibus saepe aggregatis dense fasciculati, pro genere magni, applanati ad 1·5 cm. diametro, teste lectore virides rubro-tincti ; bracteae conspicuae, scariosae, siccitate brunneo-rubrae, extra pubescentes, 3–5 mm. longae ; pedicelli 0·9–1·3 cm. longi, 1·5–3 mm. supra basin articulati, pilosulo-pubescentes ac infra articulum griseo-tomentosi. *Calycis* lobi elliptico-ovati vel elliptico-oblongi, apice rotundato-obtusi, flore aperto patuli, 7–7·5 mm. longi, 4·5–4·75 mm. lati, utrinque dense pulverulento-pubescentes atque ciliolati, marginibus late pallidiores albescentes. *Stamina* 10–11 ; filamenta pilosula, 4–5 mm. longa ; antherae orbiculares, 1·3 mm. longae, 1·5 mm. latae, connectivo glandulis parvis compluribus rubro-brunneis marginato, ceterum eglandulosae glabraeque. *Disci* processus cum staminibus alternantes eisque basi cohaerentes, claviformes, pilosuli, ad 3 mm. longi. *Ovarium* ovoideum, pilosulum, 2·5 mm. longum, 2–2·5 mm. diametro ; stylus pilosulus vel superne glabrescens, 1·75–2·75 mm. longus ; stigma globoso-capitatum, simplex, 1 mm. diametro. *Fructus* haud visus.

Ecuador : prov. Pichincha ; Canton Quito ; in remnant of wood on crest to right of road from Nono to Gualea, 3200 m., Sept. 13th, 1935, *Mrs. Ynes Mexia* 7674 (type in Kew Herb.). " Tree 7 m. high, umbrella crown ; green flower tinged with red ; wood soft, used to make wooden spoons ".

Vernacular name, *Platoquero*.

This species is quite unlike any known to me from description or in the herbarium, while the high altitude at which it was found is also unusual for a member of this genus. I have, indeed, been unable to find any convincing specific affinity. Even the branchlets and leaves of this plant have an individual facies, and the large flowers in dense fascicles on the old wood are quite peculiar. Other notable characters are the pale margins of the broad calyx lobes, the conspicuously hairy filaments, and the series of small reddish-brown glands bordering the connectives of the anthers, which otherwise are glabrous and have no large dorsal or apical gland.

DEWILDEMANIA O. HOFFM.

B. L. Burtt.

Since its original publication in 1903 the African genus *Dewildemania* (*Compositae–Vernonieae*) has remained monotypic in the published records, but for the last 17 years three representatives have been recognized in the Kew herbarium. When studying African *Compositae* at Brussels in the summer of 1932 I examined the material of *Dewildemania filifolia* O. Hoffm., which was previously known to me only from description. It was at once apparent that this was the genus in which an anomalous species of *Athrixia* in the Kew herbarium, *A. stenophylla* Baker, should be placed. Shortly afterwards a third species, now described as *Dewildemania platycephala*, was received in a collection of plants made by Mr. G. W. St. Clair Thompson in the Mbeya district of southern Tanganyika in 1932.

The genus *Dewildemania* is one of the few genera of the tribe *Vernonieae* which has a paleaceous receptacle. At the time of its first description it was unique among the African genera in this respect, but since then the establishment of *Gossweilera* by S. Moore (in Journ. of Bot. 46 : 291, 1908) has provided a second genus with this character, while it seems that *Omphalopappus* O. Hoffm., originally placed in the tribe *Helianthoideae*, is better referred to *Vernonieae*. The second distinctive feature of *Dewildemania* lies in the pappus : this is biseriate, the outer series consisting of broad scales, the inner of very narrow scales or setae. Taken in conjunction with the tribal characters of anthers and styles and homogamous flowers, the features of paleaceous receptacle and of the pappus are diagnostic of the genus *Dewildemania*.

The organization of the capitulum in *Dewildemania filifolia* is most interesting in its simplicity. The filiform leaves become shorter and more congested towards the top of the stem and pass, without any abrupt change, into the involucral bracts which are in turn replaced acropetally by the paleae of the conical receptacle ; paleae which in shape, size and texture are but slightly differentiated from the bracts. As is normal in *Vernonieae* there is no functional specialization between the inner and outer flowers of the capitulum ; all have tubular 5-lobed corollas and all are hermaphrodite.

The existence of such a simple capitular organization in *Vernonieae* emphasises, according to one's personal prejudices, either the possibility of the polyphyletic origin of the family, or doubts about the primitive nature of either *Helianthoideae* or *Senecionideae*, one of which tribes is usually taken as primitive in the family by those who believe it to be monophyletic (cf. Hutchinson, British Flowering Plants, 210 : 1948 ; and Small, The Origin and Development of the Compositae, 1919).

D. stenophylla also has filiform leaves, but the peduncles in this species are almost naked and the transition to involucral bracts, which are lanceolate-acuminate, is more abrupt. In this species the receptacle is turbinate, the involucral bracts being borne on the sides, the flowers on the flat top.

In *D. platycephala* the difference between the lanceolate-elliptic foliage leaves and the linear bracts is quite clear cut. The receptacle is flat and the original description of the genus must be amplified to include flat, turbinate or conical receptacles.

KEY TO THE SPECIES.

Leaves narrowly linear

Capitula solitary, 2 cm. diam. ; peduncles leafy to top ; inner pappus 2·5 mm. long, the outer 2 mm. . . 1. *D. filifolia.*

Capitula in loose corymb, 1 cm. diam. ; peduncles with 1 or 2 scattered reduced leaves ; inner pappus 1 mm. long, the outer 0·75 mm. . . . . 2. *D. stenophylla.*

Leaves elliptic or lanceolate-elliptic ; heads solitary ; receptacle flat ; flowers numerous, inner pappus 4 mm. long, the outer 2·5 mm. 3. *D. platycephala.*

1. D. filifolia *O. Hoffm.* in Ann. Mus. Cong. ser. 1, 4 : p.x (1908).

BELGIAN CONGO. Katanga : Lukafu, Kamkusso-Kusso ; Feb. 1900, *Verdick* 418.

I am indebted to Prof. W. Robyns for the loan of this specimen from the Brussels herbarium.

2. D. stenophylla (*Baker*) *B. L. Burtt*, **comb. nov.**

Syn. *Athrixia stenophylla* Baker in Kew Bull. 1897, 270.

NYASALAND. Nyika plateau, 1800–2100 m. ; July 1896, *Whyte* 219.

3. D. platycephala *B. L. Burtt*, **sp. nov.** a *D. stenophylla* et *D. filifolia* foliis latioribus, capitulis majoribus multifloris, receptaculo fere plano, receptaculi paleis latioribus facile distinguenda.

Herba erecta ; caules simplices (singuli ?), ad 25 cm. alti, densius foliati. *Folia* elliptica vel lanceolato-elliptica, ad basin subito ad apicem acutum sensim angustata, 2–3·5 cm. longa, 0·5–1 cm. lata, margine leviter revoluta, utrinque glabra, glanduloso-punctata, obscure trinervia. *Capitula* solitaria, hemisphaerica, in siccitate 1·75–3 cm. diametro. *Involucri bracteae* numerosae, circiter 4-seriatae, lineari-lanceolatae, circiter 10 mm. longae et 1·5 mm. latae, glabrae vel leviter pubescentes et marginibus ciliatae. *Receptaculum* subplanum, paleaceum. *Receptaculi paleae* bracteis involucralibus similes sed lineares, apice subito et breviter acuminatae, 7·5 mm. longae, 1·5 mm. latae, glabrae. *Pappus* (anthesi) biseriatus ; squamae exteriores 5, paleaceae, 2·5 mm. longae et 1 mm. latae, plus minusve oblongae, apice laciniatae ; interiores 5, subsetosae, 4 mm. longae, barbellatae. *Corolla* 8–10 mm. longa, lobis 2–2·25 mm. longis, pilis paucis ad apicem loborum exceptis glabra. *Antherae* 1·5 mm. longae, basi breviter sagittatae. *Stylus* superne breviter pilosus, ramis subulatis. *Achaenia* immatura ut videtur pentagona, angulis breviter pilosa, faciebus glandulis sessilibus (rubris ?) praedita.

TANGANYIKA TERRITORY. Mbeya district : Mbosi, 1500–1680 m. ; erect herb to 2 ft., usually 1½ ft., flowers bright purple, leaf rather pale green ; gregariously common, not well distributed ; habitat (1) more open *Brachystegia–Isoberlinia–Uapaca–Protea* woodland, especially on rocky outcrops, (2) near stream where grass growth not long ; 29 March 1932, *G. W. St. Clair Thompson* 1079.

VICIA MONANTHA RETZIUS.

B. L. Burtt and P. Lewis.

Introduction

Vicia calcarata Desfontaines is the name by which the material now to be studied is most widely known : it has had a chequered history. By some authors it has been used in a broad sense, by others more narrowly, a second closely allied species being accepted, generally as *V. cinerea* M. Bieb. More recently Maire, who favours the broad view of the species, has successively replaced the name *V. calcarata* by *V. biflora* Desf. and *V. monantha* Retz. The latter is certainly the oldest name for a member of this group, it was adopted by Fiori and Paoletti (Fl. Anal. d'Ital. 2 : 119. 1899), but the limits of the material to which it should be applied need clarifying.

V. monantha Retz. is liable to nomenclatural confusion with *V. monanthos* (L.) Desf. which must be treated as a later homonym of it and is now to be known as *V. articulata* Hornem. (see, for instance, Hegi, Ill. Fl. Mitt-Eur. 4, pt. 3 : 1514. 1924). This is a most distinctive species of the *Ervum* group and is easily recognised by its characteristic stipules, one member of each pair being small and simple, the other having a definite stalk, suborbicular blade and a fringe of tentacle-like teeth that often render it effectively palmatisect. Such stipules are unique in the genus.

V. monantha Retz., it may be mentioned, has been rather frequently confused botanically with *V. peregrina* L. The two species are found in similar areas and have a slight superficial resemblance, but there are really no grounds for confusion, for *V. peregrina* has sharply retuse leaflets, constantly solitary flowers, more gibbous calyx, larger corolla with erect standard, and pubescent pod.

An investigation which started merely as an attempt to apply the name *V. monantha* to the appropriate herbarium covers, has led us into deeper waters and has tempted us to see how far the analysis of this group can be pursued by the investigation of ordinary herbarium material. No special collectings have been made and consequently the specimens are in many ways inadequate. The study has, however, been justified because this species-group, ranging as it does over nearly 6,000 miles of longitude in regions often possessing an almost desert climate, is unlikely to be subjected to investigations by experimental methods in the foreseeable future. In this respect, of course, it resembles by far the greater number of critical groups with which the herbarium taxonomist comes into contact, and it is clearly essential to push normal morphological methods up to their valid limits. The present paper is particularly concerned in determining where, in the example of *Vicia monantha*, these limits may lie.

Botanical Analysis

Establishment of the major groups.

A preliminary sorting of the material of *V. monantha* seemed to indicate that two major groups were represented, and a rough key was constructed to separate them :—

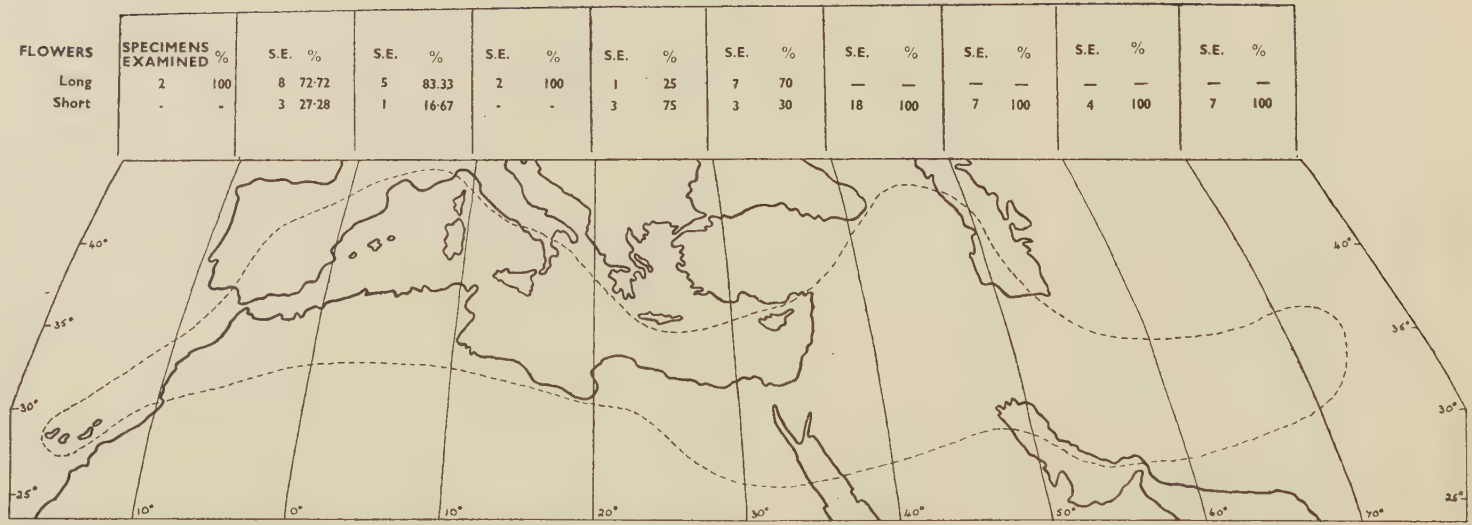

Fig. 1. Range of *Vicia monantha* Retz. and longitudinal distribution of variation in terms of flower length and pod width.

Pod 10–12 mm. broad ; seeds black (very dark even when young) ; hilum 2 mm. ; flowers 17 mm. long. A coarse leafy plant, the inflorescences often bearing several flowers . . . . . A.

Pod. 8 mm. broad ; seeds brown or mottled ; hilum 1·5 mm.; flowers 14 mm. long. A more slender, less leafy plant, often much branched from near the base, the inflorescences generally one-flowered . . B.

It was also noted that, in general, type A was western, while type B was eastern, though its extension westward from Egypt to Morocco overlapped most of the range of type A. It was clear, moreover, that the measurements given in the rough key, and derived from a few easily classified individuals, were far too rigid, and it seemed likely that their necessary relaxation would well-nigh obliterate the differences between the two groups. A more detailed investigation was therefore commenced.

Using the name *V. monantha* Retz. in its broadest sense we have had available for examination some 88 herbarium specimens which lie within the rough distribution area shown on the map (fig. 1). Additional records from Britain, East Africa and Australia have been omitted, as in these stations the species is clearly an alien.

These 88 specimens suffer from all the disadvantages usually associated with herbarium specimens. Less than half (37) carry both flowers and fruits, and even some of these have pods so immature that the correlation of flower and fruit sizes is uncertain. Geographically the 88 specimens represent anything but a random sample through the species range. In the Kew Herbarium the representation from the Middle East area (Iraq etc.) is considerably stronger than that from N. Africa, while another disadvantage is that the picture may be distorted by the presence of too many specimens from a few convenient localities, such as Oran, Cairo and Baghdad.

The available material was analysed and the characters tabulated, special attention being paid to size of flower and pod. The question then arose as to the best method of presenting the data so obtained. Owing to the large range of the species and the number of specimens involved, it was obviously impracticable to plot the results directly on to a map, as one of adequate scale would either have had to be much folded or cut up into numerous sections, and the picture as a whole would have neen lost. It was therefore decided to tabulate the two main characters, overall flower size and pod width, in blocks covering 10° of longitude. The data, presented in this way, is shown on fig. 1 ; before considering it in detail it will be necessary to justify the use of the apparently arbitrary categories " flowers long ", " flowers short ", " pods broad ", " pods narrow ".

Flower size is plotted in the form of a histogram in fig. 2 and pod width in fig. 3. These histograms are of some value in showing the size-distribution of each character, but it is doubtful if the method is strictly applicable, as the data used are not based on a random collection of material ; for instance, the geographical bias from Iraq strongly affects the histogram for flower-size. This histogram is, in fact, unsatisfactory in showing the break between large and small flowers and it is perhaps more significant that only 6 out of 69 (9 per cent.) of the specimens examined fall into the borderline class. These specimens are considered individually later on.

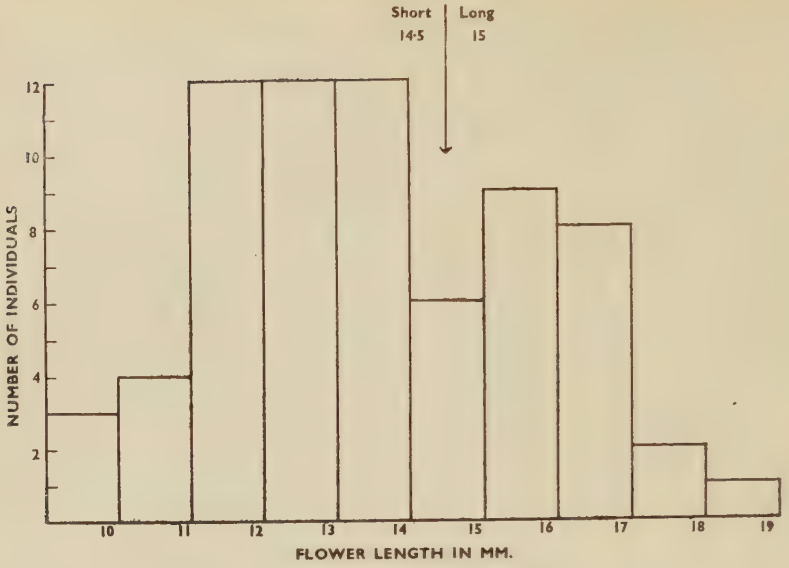

Fig. 2. Frequency distribution of flower length.

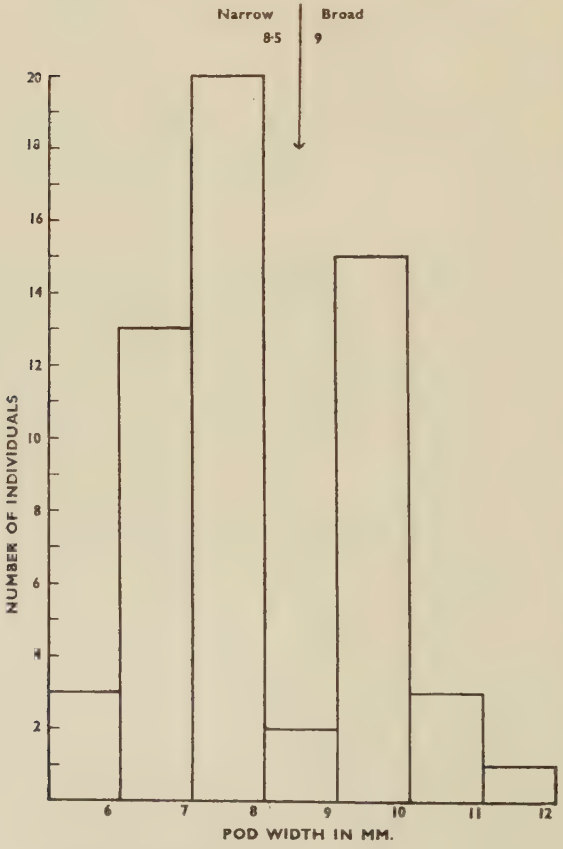

Fig. 3. Frequency distribution of pod width.

The salient feature in the geographical distribution of both characters is, as was apparent in the preliminary investigation, that the larger form is restricted to the western half of the area. The fact that the two features of flower-size and pod-width are correlated is shown graphically in fig. 4; the value of this demonstration is however considerably lessened by the fact that it can only be based on the 37 specimens of which we have both flower and fruit and these include less than half of those with flowers in the critical group 14–15 mm. (inclusive).

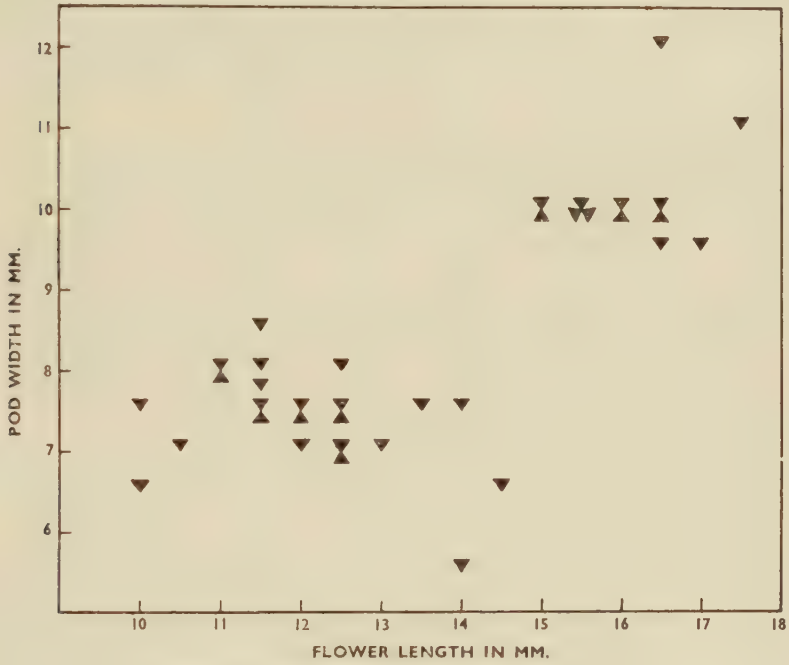

Fig. 4. Correlation of size of flower and pod.

As indicated in the preliminary key, flower-size and pod-width are not the only characters separating these two groups. Other characters examined will now be considered separately :—

Vegetative characters

It must be admitted that the vegetative differences suggested in the preliminary key do not hold satisfactorily over the whole range of material examined. The large-flowered plant is more often coarse and leafy, but some specimens (e. g. *Ellman & Sandwith* 1016 from Lorca, Spain) are relatively dwarf, branched, and with narrower leaflets, and in general vegetative facies approach closely to the normal type of small-flowered plant from the Middle East area. Specimens of the large-flowered plant from Egypt are almost uniformly coarse and leafy, while those of the smaller-flowered form from around the Experimental Farm at Rustam, Baghdad are often larger coarser plants than usual, though still much branched from near the base. Vegetatively the habit of the Egyptian plants is approached more closely by a few specimens from N.W. India (Chitral and Rawalpindi) which have a coarse leafy stem with broad leaflets, and are but little branched.

Character ...	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
	Width of standard			Length of wings			Width of wings		
Large-flowered group ... (7 specimens)	6·5 mm.	7·4 mm.	8 mm.	14 mm.	15·1 mm.	16·5 mm.	2 mm.	2·75 mm.	4 mm.
Small-flowered group ... (15 specimens)	4·5 mm.	5·7 mm.	7·5 mm.	10·5 mm.	11·7 mm.	12·5 mm.	1·5 mm.	1·9 mm.	2·5 mm.
	Length of keel			Width of keel			Length of calyx		
Large-flowered group ...	12 mm.	13·1 mm.	14 mm.	2·25 mm.	2·5 mm.	2·5 mm.	5 mm.	5·9 mm.	6·5 mm.
Small-flowered group ...	9 mm.	10·5 mm.	11·5 mm.	2 mm.	2·3 mm.	2·5 mm.	4·5 mm.	5·1 mm.	6 mm.
	Length of ovary			Width of ovary			Number of ovules		
Large-flowered group ...	10 mm.	11·6 mm.	13·5 mm.	1·5 mm.	2·1 mm.	3 mm.	6	6·3	7
Small-flowered group ...	7 mm.	10 mm.	11 mm.	1 mm.	1·7 mm.	2·5 mm.	4	5·3	7

Fig. 5. Range of floral measurements in the two groups of Vicia monantha.

On the other hand specimens from Caucasia, where under a higher rainfall greater luxuriance might have been expected, are uniformly dwarfish plants much branched from the base and with narrow leaflets. *V. monantha* is here, however, at the northern limits of its range.

Inflorescence

The number of flowers varies from 1 to 5 and there is not unnaturally a tendency for the higher number to be borne on the larger plants, especially those with relatively long unbranched stems. There is, however, no absolute constancy in this and some large plants (e.g. *Keller* 129 from near Cairo) have solitary flowers.

Floral characters

Flower size, in terms of the overall length of the standard, has already been discussed and the existence of two main classes demonstrated. Other floral dimensions are evidently correlated with these and the table (fig. 5) gives the range of measurements in each group.

Fruit characters

In the initial analysis the measurement of pod width alone was used. It is, in fact, reinforced by a consideration of pod length, as is shown by the following figures :—

	Pod Length		
	Minimum	*Mean*	*Maximum*
Large-flowered group ... (18 specimens)	32 mm.	40·2 mm.	49 mm.
Small-flowered group ... (35 specimens)	23 mm.	27·1 mm.	33 mm.

The legumes are normally glabrous, but forms with long silky hairs, especially near the sutures and on the young pods, have been found both in the large-flowered and small-flowered groups. These have been named var. *dasycarpa* Maire and var. *trichocarpa* Maire respectively.

The pubescence of the inner surface of the legume is also a variable character ; it appears to be correlated with that of the seed-coat (see below).

Seed characters

(a) Measurements. In the whole group seed diameter has been found to vary from 2·5–5 mm., none of the examples exceeding 4 mm. having been found east of Egypt. It is probably correct to say that the seeds of the large-flowered type are 3·5 mm. in diameter and over, but the difficulty in assessing this character on specimens often dried before the fruit was fully ripe makes its rigorous use in classification difficult.

The size of the hilum varies in much the same way. Only one of the large-flowered specimens has seeds with hilum as small as 1·5 mm. : all the rest were measured as 2 mm. Amongst the small-flowered group the hilum normally varies from 1·25–1·75 mm. with a definite mode at 1·5 mm., while two exceptional measurements of 1 mm. and 2 mm. respectively have been recorded.

(b) Seed coat. The seed coats of *V. monantha* vary in ground colour, in the presence or absence of mottling, in surface texture and in pubescence.

All mature seeds examined in the large-flowered group were very dark, and immature seeds are also usually dark. In the small-flowered group both light and dark seeds occur and in this respect our preliminary key was at fault ; light coloured seeds seem to predominate in the Middle East area, but data here too often refers to immature seeds to be wholly reliable.

When examined under strong illumination some of the dark seeds show that the ground colour, which then appears a brighter reddish brown, is masking the presence of a pattern of almost black mottling. This mottling is quite conspicuous in the lighter coated seeds (cf. *V. monantha* var. *marmorata* Maire). Mottling may occur throughout the geographical range of the species and is present in about a third of the specimens examined.

Fig. 6. Seed variation in *V. monantha*. A, subsp. *triflora* (Thomas, Sardinia), × 6 ; B, subsp. *cinerea* (Dickson 323, Kuweit), × 6, with part of surface × 16 ; C, subsp. *cinerea* (Noë, Mohammera, S.W. Persia), × 6, with part of surface × 16.

Differences in maturity of the specimens has made it very difficult to place them in definite classes according to the nature of the seed coat. The extreme of sculpturing is exhibited by complex pitting and wrinkling of a specimen (*Noë*, 1850) from Mohammera on the Iraq–Iran border (fig. 6). The same pattern, often less strongly developed, appears on other specimens scattered through the whole area of the species. A much smoother surface is produced, however, when the wrinkles are even more developed and form the apparent surface of the seed, leaving only small but deep pits between (e.g. *Aitchison* 521 from Afghanistan).

At the other extreme we find smooth seed-coats, especially in some of the light brown, mottled seeds ; but even then it is not possible to say for certain if the seed coat is smooth throughout development, or whether there may not be some early pitting or wrinkling which is eventually smoothed out in the ripe seed. This certainly does seem to happen in some cases (e.g. *Dickson* 323 from Kuweit; in this specimen the surface of the immature seed is quite decidedly wrinkled, but the ripe seeds have only slight shallow depressions, and as seen under the hand-lens may be classed as smooth).

(c) Pubescence. By far the greater proportion of the seeds examined is glabrous, and this is correlated with a very scanty and often patchy development of hairs on the inner surface of the pod. Occasionally the seeds have a thin covering of weak woolly hairs and then the indumentum of the inside of the legume consists of a uniform and well developed pubescence.

Looking at the seed characters as a whole we may say that those affecting size show some correlation with the size relations of the other parts of the plant. Those concerning the features of the testa are more irregularly distributed, and, although the dark-coloured seeds are most often found in the broad type of pod, the characters cannot at present be utilized to support the division of the material into two major groups.

Specimens intermediate between the major groups in flower size

The specimens considered under this heading are those with flowers 14–15 mm. long. They number 11 in all. Of these, three, having flowers 15 mm. long, are clearly to be associated with the large-flowered group on account of their other characters, two of them having pods 10 mm. broad, while the third (*Keller* 257 from near Cairo) in length of wing (13·5 mm.) and of keel (12·5 mm.) comes within the range of these characters shown by the large-flowered group (see fig. 5).

In the 14·5 mm. group there are three specimens. *Bornmuller* 292 from S. Persia has a pod (somewhat immature) only 6·5 mm. wide and is clearly to be associated with the small-flowered group. *Shabetai* 139 from Giza, Egypt, is intermediate in length of standard and wings, but the length of the keel (11·5 mm.) lies at the upper limit of size for the small-flowered group, and in this character the groups appear not to overlap. This one measurement, however, supplies the only evidence for definite allocation to one group or the other, as the specimen is without fruits and in general facies might easily be referred to either. The third specimen, collected by *Xatard* in the eastern Pyrenees, is intermediate in length of wings ; it has the narrow standard (5 mm.) of the small-flowered group with which its slender habit is also in accord, but the length of the keel (12 mm.) belongs rather to the large-flowered plant ; there are no fruits. With such material as these last two specimens the determination cannot be carried beyond the specific level.

Five specimens have flowers 14 mm. long ; four of them come from lands east of the Mediterranean Sea and on geographical origin as well as on their other characters they may be safely referred to the small-flowered type. The fifth specimen (*Wilczek and Dutoit* 43 from Debdou in Morocco) has floral measurements that suggest the larger-flowered group without being in any way decisive : it has, for instance, wing-petals 13·5 mm. long and keel 12 mm. long. The fruits are too young for measurement and the specimen can only be determined as *V. monantha*.

To summarise these awkward specimens it may be said that, taking into consideration all their characters, only three of them cannot be allocated satisfactorily to one group or the other. These three certainly appear to be intermediate in floral characters, but as they all lack fruits it is impossible to say whether plants intermediate in all their features do really occur.

Taxonomic conclusions

The data analysed above disclose that there are two major groups in the material examined. The one, with large flowers and broad pods is predominantly western ; the other, with smaller flowers and narrower pods is chiefly eastern, but the area of overlap is large, extending from Egypt to Morocco. The fact that the two groups remain generally separable, in spite of their occurrence together in this intermediate area, provides the strongest argument in favour of their both being accorded specific rank ; treatment which would be in line with practice in current zoological taxonomy (cf. Mayr, Systematics and the Origin of Species). In botany, however, the greater possibility of ecological differentiation (an aspect of variation as yet uninvestigated in *Vicia monantha*) rather weakens this argument.

Most orthodox taxonomists would probably demur at the specific recognition of groups distinguished almost entirely by differences in the average size of parts. In *V. monantha* we have conspicuously failed to find qualitative characters to reinforce these more obvious differences in size ; it may be noted, also, that the apparently qualitative features of seed colour and coat may well be regarded as being dependent on quantitative development of seed pigmentation and irregularity of surface.

We have concluded that, from the evidence at present available, all the material examined must be placed in a single species.

Clearly, however, the two size-classes, linked as they are with a geographical bias, require some taxonomic recognition. There is no uniformity amongst botanists in the use of the various categories below the rank of species. Herbarium workers necessarily use " variety " in a rather non-committal sense ; a pigeon-hole for an observed variant of unknown significance. The same term is, however, also used with more precision for morphological variations evaluated by the author concerned as being of relatively minor importance. There is little precedent for the deliberate use of variety for major infraspecific groups which have a considerable geographical range and of which knowledge has progressed at all beyond the purely non-committal stage. For such groups the category " subspecies " is generally regarded as more appropriate. In accepting this rank (for the major groups of *V. monantha*) we are following Maire, who has first-hand acquaintance with the species in the area where these groups overlap. It also seems probable that they are of more or less equivalent value to the subspecies recognised by Babcock in Crepis (Babcock, The Genus Crepis, in Univ. Calif. Publ. Bot. 21 & 22. 1947) and by other experimental workers.

Within these two subspecific groups we have found no correlation of characters such as would justify the recognition of taxonomic units of lower rank.

Botanical history

The synonymy and references given in the synopsis of classification which follows make a detailed account of the botanical history of this species unnecessary. This section will be concerned with two main items : the identity of the type specimens of the various names involved,

and a very brief consideration of the taxonomic treatments accorded to the group by Murbeck and, later, Maire in their studies on the North African flora. No other authors have dealt with it in any detail.

For convenience of reference names are here arranged alphabetically : chronological sequence is shown in the succeeding section :—

1. *V. angulata* Willk.

This name was proposed for a Spanish plant from near Seville, differing from *V. calcarata* in having several flowers in an inflorescence. We have referred this to the large-flowered sub-species, but with some doubt for, as has been noted above, the number of flowers is not strictly diagnostic.

2. *V. biflora* Desf.

3. *V. calcarata* Desf.

It is convenient to consider these together. The identity of Desfontaines' type specimens has been discussed both by Murbeck (Contr. Fl. N. O. Afr. 1 : 74. 1897) and by Maire (in Bull Soc. d'Hist. Nat. Afr. Nord, 19 : 44. 1928). Both authors have concluded that the names refer to a single form, one being applied to flowering, the other to fruiting material. The type specimens were kindly sent on loan to Kew by the Director of the Museum d'Histoire Naturelle, Paris, and we are in full agreement with these conclusions.

The specimen of *V. biflora* has flowers 16·5 mm. long, while that of *V. calcarata* has pods 35 mm. long and 10 mm. broad. Both may therefore safely be referred to the large-flowered subspecies. *V. biflora* and *V. calcarata* both came from Algeria.

4. *V. cinerea* M. Bieb.

We have not seen the type of this species, but it was described from the Caucasus and all Caucasian specimens seen (including one from Tiflis, the type locality) clearly belong to the small-flowered subspecies. Unfortunately the complete lack of measurements in the original description makes it relatively valueless for our purposes. Fedtschenko (in Komarov, Fl. U.R.S.S. 13 : 418. 1948) gives the following characters: flower 10–14 mm. long ; pod 22–30 mm. long, 5–6 mm. broad ; seeds dark brown.

5. *V. cossoniana* Batt.

Battandier noted that this was a smaller plant than that which he called *V. calcarata*. Measurements given in the original description are 25–30 mm. for pod length and 8 mm. for pod width ; the seeds are said to be reddish 3–4 mm. in diameter. These characters are those of the small-flowered subspecies, except for the upper limit of seed-diameter, which we have already noted is rather unreliable.

The species was based on a specimen in the Cosson herbarium, and localities cited are Batna, Lambèse, Aflou and Djelfa, all these being in Algeria.

6. *V. gracilis* Banks & Soland.

The type specimen, collected by Alexander Russel near Aleppo, is preserved in the herbarium of the British Museum (Natural History).

It is a fragment of small size, but the flower length (14 mm.) confirms the botanical identity (with the small-flowered group) expected from its country of origin.

7. *V. griffithii* Baker.

Baker's citation of materials is :—

" Punjab, at Rawul Pindee and Futteyjung, *Dr. Aitchison.*

Distrib. Afghanistan. *Griffith*, 1114 ".

Despite the name there is no case for taking the Griffith specimen as the type of species ; it is not even written up by Baker himself. His description is evidently drawn from *Aitchison* 1045 from Rawulpindee (flowers) and *Aitchison* 1046 from Futteyjung (fruits) ; in case of later argument it may be as well to designate the former of these a lectotype of the species. The flower is 13·5 mm. long, wings 12·5 mm. and keel 10 mm. The fruiting specimen has pods 26 mm. long and 7·5 mm. broad. The habit of these plants is rather coarse (see p. 501 above) and altogether the specimens represent plants near the upper limit of the small-flowered subspecies.

V. griffithii has not previously been included in the synonymy of this group.

8. *V. monantha* Retz.

No country of origin was given by Retzius. The type specimen could not be discovered in his herbarium at Lund, but was found in the Stockholm herbarium and has been kindly sent on loan for our examination. It consists of a single piece of a branch bearing four expanded leaves, the lower three having solitary axillary flowers on peduncles more than half the length of the internodes. The flowers are 14 mm. long, and, by analogy with the other specimens discussed above, we accordingly refer it to the small-flowered subspecies.

9. *V. triflora* Tenore*.

We have not seen any authentic material of this species, and Tenore's own descriptions give no accurate measurements. His plate seems to represent the large-flowered plant, and if it be drawn accurately at natural size, the flowers are about 16 mm. long. Fiori gives the measurements of *V. monantha* (in which he includes *V. triflora*) in Italy as : flower 15-17 mm. long, pod 40 mm. long and 10 mm. broad. All these figures refer to the large-flowered plant, and are confirmed by the only three specimens (in the British Museum Herbarium) that we have seen from Italy and Sicily. Fiori and other Italian authors state that this plant is also found in Sardinia : both the Sardinian specimens we have examined also belong to the large flowered subspecies. We conclude, therefore, that *V. triflora* Ten. must be referred to this group : an important decision as it was the first name to be given subspecific rank and it must therefore be adopted under *V. monantha* Retz.

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*This species has been confused by Reichenbach and others with *V. melanops* Sibth. & Sm., a species lying far outside the group under discussion.

10. *Orobus viciiformis* Lagasca.

This is an illegitimate name. The author included two varieties : α, with solitary flowers, in which he placed *V. calcarata* Desf. and *V. monantha* Retz. and β, with 2–7 flowers.

Murbeck (Contr. Fl. Nord-Ouest Afr. 1 : 74. 1897) was the first botanist to consider critically whether two species were passing under the name *V. calcarata* Desf., which was then the current name for the group. He concluded that *V. calcarata* (incl. *V. biflora*) and *V. cinerea* could be distinguished and the characters given by him are as follows :—

	V. calcarata	*V. cinerea*
Number of flowers ...	2–4	1–2
Length of flower ...	15–17 mm.	12–15 mm.
Length of pod	35–40 mm.	30 mm.
Width of pod	10–12 mm.	7– 8 mm.
Diameter of seed... ...	5– 5·5 mm.	4 mm.
Hilum	1/6 circumference	1/8 circumference
Seed-colour	Almost black	grey-brown

Under *V. calcarata* he cited Spanish and North African specimens, but gave the geographical distribution as extending to Egypt and Central Persia. Under *V. cinerea* he cited several North African and one Palestinian specimen. He suggested that observations on the whole range of oriental material might give reason for considering *V. cinerea* as only a subspecies of *V. calcarata*. This is, in effect, what our present investigations have shown.

Maire has dealt at length (in Bull. Soc. d'Hist. Nat. Afr. Nord. 19 : 44. 1928) with the precise identity of Desfontaines' specimen and has demonstrated the errors in his descriptions which have led to the confusion surrounding *V. biflora* and *V. calcarata*. Maire concluded that only one species was involved and adopted for it the name *V. biflora* Desf. because that species was placed first by Desfontaines. Such grounds are, however, not acceptable under the Rules of Nomenclature and Maire should have followed the lead of Murbeck, who was the first author to unite them and who deliberately chose to use the name *V. calcarata*.

Maire's next treatment of the group came in July 1932, and he divided *V. biflora* into two subspecies, *calcarata* (Desf.) Maire and *cinerea* (M.B.) Maire. He carried his nomenclature yet further and distinguished in each subspecies a typical variety, strangely named var. *eubiflora* Maire under subsp. *calcarata* and var. *cossoniana* (Batt.) Maire under subsp. *cinerea*. He also described two parallel varieties, one under each subspecies, distinguished by their hairy pods. Later in the same year Maire altered the name of the large-flowered subspecies to subsp. *eubiflora* Maire.

In 1939 Maire and Weiller added another trivial variety to subsp. *cinerea*, var. *marmorata*, of which the marbled seeds were taken as a distinctive feature, a view which we cannot endorse (see p. 504 above).

In 1940 Maire adopted the name *V. monantha* Retz. for the whole species and his infra-specific classification was :—

subsp. *eubiflora* (Maire) Maire
subsp. *cinerea* (M.B.) Maire
var. *leiocarpa* Maire (V. cinerea M.B. sens. strict.)
var. *trichocarpa* Maire
var. *marmorata* (Maire & Weiller) Maire

It will be noted that the varieties under subsp. *eubiflora* have now been omitted. The new varietal name, *leiocarpa*, under subsp. *cinerea* is illegitimate, the epithet *cinerea* itself (*V. calcarata* var. *cinerea* Boiss.) having priority in this rank.

In the following synopsis only the main synonyms and references have been given : no attempt has been made to search floristic papers and local floras and it may be that there are infra-specific names of which no material has been examined.

Synopsis of classification

The most useful characters for distinguishing the subspecies may be summarised as follows :—

Standard 14·5–19 mm. long ; wings 14–16·5 mm. long ; keel 12–14 mm. long ; pod 32–49 mm. long, 8·5–12 mm. wide ; seeds usually exceeding 3·5 mm. diameter and blackish . subsp. *triflora*

Standard 10–14·5 mm. long ; wings 9–12·5 mm. long ; keel 9–11·5 mm. long ; pod 23–33 mm. long, 6–8·5 mm. wide ; seeds usually not exceeding 3·5 mm. diameter and brownish. subsp. *cinerea*

Vicia monantha *Retz.* Obs. Bot. 3 : 39 (1783) ; Maire in Bull. Soc. d'Hist. Nat. Afr. Nord 31 : 17, no. 3141 (1940) ; Emberger and Maire, Cat. Pl. Maroc. 4 : 1053 (1941).

Syn :—*Orobus viciiformis* Lagasca, Gen. & Sp. Pl. 22 (1816).

Subsp. **triflora** (*Ten.*) *Burtt & Lewis* comb. nov.

Syn :—*V. calcarata* Desf. Fl. Atlant. 2 : 166 (1799) ; Murbeck in Contr. Fl. Nord-Ouest Afr. 1 : 74 (1897).

V. biflora Desf. Fl. Atlant. 2 : 166 (1799).

V. triflora Ten. Prodr. Fl. Nap. XLII (1811) et Fl. Nap. 5 : 114 (1835–36) et Fl. Nap. Atlas 4 : t. 172 (1811–38).

?*V. angulata* Willk. in Bot. Zeitung, 5 : 429 (1847).

Cracca calcarata (Desf.) Gren. & Godr. Fl. de Fr. 1 : 47 (1848).

Ervum calcaratum (Desf.) Trautv. in Acta Hort. Petrop. 3 : 45 (1875).

Vicia calcarata subsp. *triflora* (Ten.) Nyman, Consp. Fl. Eur. 208 (1878).

V. monantha var. *typica* Fiori and Paoletti, Fl. Anal. D'Ital. 2 : 119 (1899) ; Fiori, Nuov. Fl. Anal. d'Ital. 1 : 931 (1925).

V. monantha var. *typica* forma *triflora* (Ten.) Fiori and Paoletti, Fl. Anal. d'Ital. 2 : 119 (1899).

V. biflora subsp. *calcarata* (Desf.) Maire in Bull. Soc. d'Hist Nat. Afr. Nord. 23 : 184, no. 1234 (July 1932).

V. biflora subsp. *calcarata* var. *eubiflora* Maire in Bull. Soc. d'Hist. Nat. Afr. Nord 23 : 184, no. 1234 (July 1932).

V. biflora subsp. *calcarata* var. *dasycarpa* Maire in Bull. Soc. d'Hist. Nat. Afr. Nord 23 : 184. no. 1234 (July 1932).

V. biflora subsp. *eubiflora* Maire in Jahand. and Maire, Cat. Pl. Maroc. 2 : 430 (1932, after July).

V. monantha subsp. *eubiflora* (Maire) Maire in Bull. Soc. d'Hist. Nat. Afr. Nord 31 : 17, no. 3141 (1940) ; Emberger and Maire Cat. Pl. Maroc. 4 : 1053 (1941).

Selected exsiccata :—

Spain. Cartagena ; Mar-Apr. 1890, *Porta and Rigo* 68.

Algeria. Biskra ; 1 Apr. 1903, *Murbeck* 27.

Egypt. Cairo ; 22 Jan. 1935, *Schimper* 20.

Subsp. **cinerea** (*M. Bieb.*) *Maire* in Bull. Soc. d'Hist. Nat. Afr. Nord. 31 : 17, no. 3141 (1940) ; Emberger & Maire, Cat. Pl. Maroc. 4. 1053 (1941).

Syn :—*V. monantha* Retz. Obs. Bot. 3 : 39 (1783), sens. strict.

V. gracilis Banks and Soland. in Russel, Nat. Hist. Aleppo, ed. 2, 2 : 259 (1794) ; Eig in Journ. of Bot. 75 : 190 (1937) [Non *V. gracilis* Lois. Fl. Gall. 460. 1807].

V. cinerea M. Bieb. Fl. Taur. Cauc. 3 : 470 (1819) ; Murbeck in Contr. Fl. Nord-Ouest Afr. 1 : 76 (1897).

V. calcarata Desf. var. *cinerea* (M. Bieb.) Boiss. Fl. Or. 2 : 590 (1872).

Ervum calcaratum var. *cinereum* (M. Bieb.) Trautv. in Acta Hort. Petrop. 3 : 45 (1875).

Vicia griffithii Baker in Hook. Fl. Brit. Ind. 2 : 178 (1879).

V. cossoniana Batt. Fl. Alg. 2 : 74 (1888).

V. biflora subsp. *cinerea* (M. Bieb.) Maire in Bull. Soc. d'Hist. Nat. Afr. Nord. 23 : 184, no. 1234 (July 1932) ; Jahand. & Maire, Cat. Pl. Maroc. 2 : 430 (1932).

V. biflora subsp. *cinerea* var. *cossoniana* (Batt.) Maire in Bull. Soc. d'Hist. Nat. Afr. Nord. 23 : 184, no. 1234 (July 1932).

V. biflora subsp. *cinerea* var. *trichocarpa* Maire in Bull. Soc. d'Hist. Nat. Afr. Nord. 23 : 184, no. 1234 (July 1932) ; Jahandiez & Maire, Cat. Pl. Maroc. 2 : 430 (1932).

V. biflora subsp. *cinerea* var. *marmorata* Maire & Weiller in Bull. Soc. d'Hist. Nat. Afr. Nord. 30 : 276, no. 2716 (1939).

V. monantha subsp. *cinerea* var. *leiocarpa* Maire in Bull. Soc. d'Hist. Nat. Afr. Nord. 31 : 17, no. 3141 (1940) ; Emberger & Maire, Cat. Pl. Maroc. 4 : 1054 (1941).

V. monantha subsp. *cinerea* var. *marmorata* (Maire & Weiller) Maire in Bull. Soc. d'Hist, Nat. Afr. Nord. 31 : 17, no. 3141 (1940) ; Emberger & Maire, Cat. Pl. Maroc. 4 : 1054 (1941).

Character	V. monantha subsp. triflora		V. monantha subsp. cinerea		Difference of Means	Standard error of Difference
	Mean and standard error	Standard deviation and standard error	Mean and standard error	Standard deviation and standard error		
Length of flower (i.e. standard) ...	24. 16·2083 ∓0·2003	24. 0·981 ∓0·1413	44. 12·7273 ∓0·1252	44. 0·83 ∓0·0885	3·481	0·2362
Length of wings ...	7. 15·14 ∓0·3308	7. 0·875 ∓0·2338	14. 11·7 ∓0·1616	14. 0·6008 ∓0·1135	3·44	0·3681
Length of keel ...	7. 13 ∓0·2344	7. 0·62 ∓0·1657	14. 10·5 ∓0·155	14. 0·58 ∓0·1097	2·5	0·281
Length of ovary ...	7. 11·6 ∓0·4801	7. 1·27 ∓0·3395	14. 10 ∓0·2459	14. 0·92 ∓0·1739	1·6	0·5395
Length of pod ...	19. 40·4211 ∓0·8631	19. 3·7627 ∓0·6111	35. 27·4 ∓0·4746	35. 2·808 ∓0·3372	13·0211	0·9849
Width of pod ...	19. 9·975 ∓0·1695	19. 0·758 ∓0·1196	35. 7·147 ∓0·1291	35. 0·7527 ∓·0814	2·828	0·6736
Length of calyx ...	7. 5·857 ∓0·242	7. 0·64 ∓0·1711	14. 5·107 ∓0·1831	14. 0·685 ∓0·1236	0·75	0·3035

Fig. 7. Table of statistical constants of floral measurements. All figures are in millimetres. The numeral in the top left-hand corner of a square indicates the number of specimens in the sample.

V. monantha subsp. *cinerea* var. *trichocarpa* (Maire) Maire in Bull. Soc. d'Hist. Nat. Afr. Nord. 31 : 17, no. 3141 (1940) ; Emberger & Maire, Cat. Pl. Maroc. 4 : 1054 (1941).

Selected exsiccata :—

Morocco. El Ardja ; Mar. 1913, *Pitard* 3358.

Cyprus. Hagios Andronikos ; Apr. 1880, *Sintenis* & *Rigo* 463.

Caucasus. Baku ; 1882, *Pichler*.

Iraq. Tuz ; *Guest*. (Rustam 1391).

Arabia. Abu Halaifa ; 13 Mar. 1937, *Dickson* 323.

Persia. Mohammera ; Apr. 1850, *Noe*. Persepolis ; 12 Apr. 1842, *Kotschy* 229.

Afghanistan. 19 May 1885, *Aitchison* 518.

N.W. India. Rawalpindi ; 27 Feb. 1872, *Aitchison* 1045.

Statistical consideration

It is now generally accepted that statistical techniques have their proper place in modern taxonomy. Anderson and Turrill (in Nature, 136 : 986. 1935) have appealed for the collection of special herbarium specimens giving a representation of complete populations and suitable for biometrical analysis ; they have themselves used material of this nature in a comparison of *Fraxinus pallisae* in two separate stations in the Balkans (see New Phytologist, 37 : 160, 1938). Gregor and his associates have made considerable use of statistical methods in their experimental studies of *Plantago maritima* (see New Phytologist, 35–41 : 1936–1942).

It is not yet clear, however, whether statistical methods are equally appropriate to normal herbarium material, which consists usually of single representatives of widely isolated populations. The samples available are infinitesimally small, not only in comparison with the total individuals of the species but in comparison with its total number of populations ; and they are not random samples. Bias may be due, for instance, to a high proportion of specimens from easily accessible localities, or to the involuntary selection of " good " specimens by collectors ; they have often been collected over a period of some 150 years. There is the danger that the introduction of statistical characters, though it can actually add nothing to the content of the metrical data, may tend to give an impression of mathematical precision which is in reality lacking.

These points all engender doubt as to the wisdom of applying what is essentially a technique of omega taxonomy to the materials of alpha taxonomy. Such doubts can, however, only be resolved or confirmed by experience, and therefore, in spite of them, we have calculated some of the normal statistical constants for the data with which we are concerned. They are submitted with considerable reservations as to their value, and the position of this section *after* the taxonomic synopsis is to be taken as indicating their secondary status.

Correlation of flower length and pod width

The diagram (fig. 4, p. 00) shows the general position and demonstrates the correlation between these two characters. The co-efficient of correlation (r) has been calculated, with the result

$$r = 0{\cdot}7225.$$

Floral measurements

The range and means of certain floral measurements have already been given (fig. 5, p. 502). The most significant measurements (length of flower, wing, keel and ovary) are given again in fig. 7, but now in the form of means and standard deviations, each with its standard error. The difference between the means of the two subspecies, and the standard error of this difference is also given. In all the cases shown in this table the difference between the means is significant (taking the conventional criterion of significance ; the difference equalling at least twice its standard error). But the measurements of calyx-length only just come up to this criterion. Whatever standard of " significance " we accept, it will probably be necessary to take a " workability " criterion which is somewhat higher, unless a large sample is available for investigation. The " significant " difference between the means of calyx-lengths in the two groups does not imply a metrical difference that can be utilised in the determination of isolated specimens.

The scantiness of the samples has been emphasised already ; by way of final warning the number of specimens on which each set of figures is based is entered in the top left hand corner of the relevant square in figure 7.

Discussion

The present study has done no more than confirm on a more detailed and, geographically, more extended basis the main taxonomic treatment of *V. monantha* as set out by Maire and previously foreseen by Murbeck.

V. monantha is a highly variable species occurring over a geographical range of such extent that adequate field or experimental investigations are under present conditions virtually impossible. It has been shown, from a study of herbarium material, that variation in size is not random and can be justifiably used to recognise two subspecies within the species. There is a distinct possiblity that occasional intermediate specimens may occur, but this has not yet been fully demonstrated as the vital specimens are unfortunately incomplete. This is one of the disadvantages from which any work on normal herbarium material must suffer, and throughout the foregoing account it has often been necessary to call attention to deficient data.

Though confirming Maire's treatment of the group as one species consisting of two subspecies, we are unable to follow him in accepting varieties based on hairiness of pod or marbling of seeds. If this were done there would be equal grounds for establishing further varieties on wrinkling of seed-coat, hairiness of inner surface of pod, etc.

We have available no shred of evidence relating to the vegetative or reproductive biology of these plants. Differences of growth may or may not be simple edaphic modifications induced by local conditions. The two subspecies may or may not be isolated by sterility barriers, ignorance about which makes it impossible to classify the minor differences (pod hairiness, etc.) found in each subspecies as parallel variations. They may be due to genes which migrate freely through the whole species population. These are things about which the herbarium taxonomist can say nothing. What we can say from a study of herbarium material is that two subspecies based on general size relations can be reasonably accepted ; variations in other characters cannot be used for the definition of

taxonomic groups, unless they can be reinforced by data from experimental studies using ecological and genetical techniques.

It may be of interest to point out that the relationship between the morphological characters of these two subspecies of *V. monantha* does seem to afford a parallel to the more complex problem of *V. sativa* L. and *V. angustifolia* L. ; a problem which still awaits critical study. The rather remarkable variations in the seed-surface in *V. monantha* are also parallelled in some degree in *V. villosa* Roth. ; this is a character that needs investigating in the genus as a whole, for where material is scanty it may easily come to be overrated.

To sum up, we see *Vicia monantha* Retz. as a single taxonomic species ranging from the Canaries to Caucasia and North West India, consisting of two subspecies whose occurrence interlaces over the area between Morocco and Egypt, without, however, the general distinctiveness of the groups being lost. Throughout the area there is variation in other minor characters and this is distributed without reference to the subspecific limits. The two subspecies are regarded merely as geographically interlacing units ; there is no evidence of a gradual transition or of a geographical cline.

Flore du Congo Belge et du Ruanda-Urundi.*—The Belgian Congo, central, vast and varied, not far off a million square miles in area, lying athwart the equator from the confines of Uganda and the Anglo-Egyptian Sudan in the north to those of Northern Rhodesia in the south, is of unique significance in considering the flora of tropical Africa, where so many species are distributed over extraordinarily wide areas. No attempt to assess the total flora of the Belgian Congo has been made since Théophile and Hélène Durand's Sylloge Florae Congolanae, published in 1909. This of course is now hopelessly out of date, for ever since an almost incessant flood of new species based on Congo specimens has poured forth, many of which, alas, do not stand on re-examination. The time is certainly ripe for gathering together this scattered legion of literature, and the appearance of the first volume of the *Flore du Congo Belge et du Ruanda-Urundi* will arouse the keenest interest not only among those directly concerned with the Belgian Congo but all students of the flora of equinoctial Africa.

The Englerian sequence of families has been adopted, and the present volume includes the gymnosperms, with, as elsewhere in Tropical Africa, a very meagre muster, and those families of dicotyledons from *Casuarinaceae* to *Polygonaceae*. Full descriptions of families, genera and species are given, and keys to the genera and species; there is no key to the families, but perhaps this is being kept in store for a later volume. Besides these major groups, various subspecies varieties and forms are similarly described and keyed. An unusual feature of the descriptions of many of the woody species is that they give much information about bark and bole ; those who have perforce to rely on such things for recognising trees in the bush will appreciate their value. But since the Flora is estimated to run to about twenty volumes, I'm afraid that it will never become a handy companion for the field-botanist on trek.

*Vol. 1, by the Comité executif de la Flore du Congo belge et le Jardin Botanique de l'Etat, Brussels : Publications de l'Institut National pour l'Etude Agronomique du Congo Belge (I.N.E.A.C.), 1948.

The nomenclature, it is refreshing to read, is in strict conformity with the International Rules. Under each species there are bibliographical references, full as regards those about the Belgian Congo, selective as to others, but always giving the original place of publication of names concerned, except strangely enough of some of the basinyms involved in double citations. A criticism of the way the synonymy is set out, applicable to many other floras besides this one, is that there is no distinction made between misapplied names and later homonyms. Only a selection of herbarium specimens is normally cited, but there is no ondication which of these are types—a most troublesome omission that might very easily be remedied in future volumes. Further headings under each species deal with its geographical distribution both inside and outside the Congo, habitat (most useful, this), vernacular names, economic uses, and finally those little critical and comparative discussions that the botanist so often welcomes more than the full-dress descriptions preceding them.

The Flora is illustrated. There are a few photos and a liberal sprinkling of habit drawings with dissections, and these seem admirably clear. I cannot help feeling, however, that a wider function for the illustrations might be considered. To take one example : the genus *Dorstenia* has a single full-page drawing of *Dorstenia homblei* De Wild.—very useful no doubt to those who don't know what a *Dorstenia* looks like, or who want to identify *D. homblei*. But how much more useful to the botanist it would be to escape sometimes from the one page-one species principle, and to have here, say, a plate showing as wide a range as possible of receptacles alone, which provide crucial diagnostic characters in this difficult genus, and whose shapes and outlines are none too easy to put across properly by words alone.

Among the larger genera worked out in the present volume are *Ficus* by MM. Lebrun and Boutique with 93 species, *Dorstenia* by Professor Hauman with 30 species, and *Loranthus* by Mlle. Balle with 67 species. In the latter account botanists will note with interest that the constellation of separate genera into which *Loranthus* was split by the late Profressor Danser again merges into *Loranthus*, his genera becoming subgenera. Besides these large genera, several of considerable economic importance, especially to foresters, are dealt with ; among these we may mention *Podocarpus*, *Juniperus*, *Celtis*, *Chlorophora* and *Coula*.

In reviewing any great and detailed work the captious critic usually finds it easy to swell his review with minor carpings—criticisms that often represent differences of opinion rather than errors—and how much of taxonomic botany does rest on opinion ! The most important question to answer is whether the work is well and honestly done, and I feel that here the answer must be yes.

It remains to congratulate Professor Robyns and the members of the Executive Committee of this flora under his presidency who have, on behalf of the Institut National pour l'Etude Agrocomique du Congo Belge, launched the most ambitious and what promises to be the largest African flora, since those of Tropical Africa and the Cape. Its completion will take long, but let us hope not unreasonably long.

J. P. M. Brenan.

THE RUSTAM HERBARIUM, 'IRAQ. PART III.

Systematic List (continued).

by R. A. Blakelock.

Campanulaceae

Asyneuma lobelioides (*Willd.*) *Hd.-Mzz.* var. **filipes** *Nábělek* in Publ. Fac. Sci. Univ. Masaryk **70,** 8 (1926) e descr.

Beribadan (Kurdistan), 1800–2100 m., Aug. 31, *Ludlow-Hewitt* 1515 ; Arl Gird Dagh, 1800–3000 m., on rocky mountain side generally growing up through dwarf *Astragalus* bushes, fls. purple, 24.7.32, *Guest and Ludlow-Hewitt* 2966.

The stem and leaves are hirsute and the leaf margin entire.

Campanula acutiloba *Vatke.*

Rowanduz Gorge, 600 m., on a rocky cliff, 25.7.32, 2971.

C. erinus *L.*

Makhlat, 165 m., among rocks under small cliffs, 29.4.33, 4268.

C. flaccidula *Vatke* (*C. singarensis* Boiss. et Haussk.)

Rowanduz Gorge, in a rocky crevice, moist shady situation under overhanging cliff face, 10.5.33, *Cuckney* 3832A.

C. glomerata *L.*

Arl Gird Dagh, 2700 m., purplish blue fl., parasitized by *Cuscuta* sp., 21.7.32, *Guest and Ludlow-Hewitt* 2842 ; do., 2550 m., among *Astragalus* bushes by a stream, deep purple fls., 24.7.32, *do.* 2944.

C. propinqua *F. et M.* var. **grandiflora** *Milne-Redhead* in Curtis's Bot. Mag. **157,** t. 9349 (1934).

Rowanduz Gorge, c. 600 m., 30.4.32, *Ludlow-Hewitt* 2360 ; Mahad (nr. Shaikhan), fodder plant, native name kozarak (K.), 24.6.32, *Salim Effendi* 2619 ; Dohuk, native name nafali gur (K.), 2.6.32, *Mekki Beg* 3262 ; Marmarut Mt. (nr. Rowanduz), Kurdistan, 600–900 m., 10.5.33, *Cuckney* 3827.

The length of the corolla varies from about 2 to 3·3 cm.

C. radula *Fisch.*

Rowanduz Gorge, 600 m., on a cliff near the stream, damp shady situation, 12.10.31, 1592.

C. sclerotricha *Boiss.*

Arl Gird Dagh (near Nawanda), 1350 m., in a hedgerow by a stream, fine blueish-white flowers, 20.7.32, *Guest and Ludlow-Hewitt* 2779 ; Amadia, 1200 m., by a millstream at Sulaf, 2.8.33, 3766.

C. syspirensis *C. Koch.*

Siah Koh (Kurdistan), 2400–3000 m., Aug. 31, *Ludlow-Hewitt* 1534 ; Chia-i-Mandali, 1800–2400 m., very common on the stony mountain

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*Continued from Kew Bull. **1948,** 375–444 (1948) ; **1949,** 41–65 (1949).

side, fls. purple, 19.7.32, *Guest and Ludlow-Hewitt* 2796 ; Arl Gird Dagh, 2700–3000 m., on the rocky mountain side, purple fls., 24.7.32, 2968.

The type specimen has not been seen.

These specimens match " Riwandous [Rowanduz], 23.6.93, *Bornmüller* 1550 " in herb. Kew. The corollas in all these specimens are adpressed hairy, not glabrous as in the original description (Linnaea **23,** 639 (1850)). Boissier, however, describes the corolla as hairy (Fl. Or. **3,** 924 (1875)).

Michauxia nuda *DC.*

Zawita Gorge, 840 m., on rocky slopes, 26.7.33, 3719 ; Zawita, 930 m., on steep limestone, 27.7.33, 4520.

Boissier describes this plant as " caule glabriuscule " (Fl. Or. **3,** 891 (1875)). In cited material at Kew (*Aucher-Eloy* 1826), as well as in Guest's material, the stem is pilose towards the base. It should be added that in other specimens at Kew (nr. Balad Sinjar, *H. Field and Yussef Lazar* 615, 656) the stem is glabrescent.

Specularia pentagonia (*L.*) *ADC.*

Dohuk, 450 m., in a cornfield, flower dark purple, 24.4.32, 2321.

The size of the corolla and the degree of constriction at the apex of the immature capsules varies somewhat in these specimens. There is some doubt whether this species is distinct from *S. speculum-veneris* (L.) Tanf.

PLUMBAGINACEAE

Acantholimon caryophyllaceum *Boiss. et Hoh.*

Chia-i-Mandali (nr. Walza), 1500–1800 m., on stony hillside forming low dense spiny cushions 1–2 ft. across, 18.7.32, 2664.

A. calverti *Boiss.* var. **tigrense** *Hd.-Mazz.* in. Ann. k. k. Nat. Hofmus. **27,** 391 (1913).

Arl Gird Dagh, 2550 m., on the mountain side, forming low dense spiny cushions, 24.7.32, 2938.

Acantholimon spp.

Koma Sang (nr. Mandali), 210 m., on the stony hillside, 9.5.30, 794 ; Zawita range, 1050 m., rocky mountain side, 25.7.33, 4454 ; Zawita, 825 m., on stony slope, 27.7.33, 4531 ; Ser Amadia, 1770 m., on mountain slope, 38.8.33, 4975.

The material of *Acantholimon* was sent to Prof. Dr. O. Schwarz, Weimar, for identification. The determinations were not received in time to go to press.

Limonium carnosum (*Boiss.*) *O. Kunzte.*

In the Jazira (nr. Wadi Tharthar), on the banks of a wadi, pink flowers, native name shuwaiwah, 16.10.32, 3554.

L. spicatum (*Willd.*) *Kuntze.*

Nr. Tuz, salt marsh, 29.3.30, 665 ; Hinaidi, on channels, 30.3.31, *Yussef Lazar* 1149 ; Jazira Desert, in small salt depressions, Mar.–Apr. 33, *Edmonds* 3795 ; Baghdad, in a field at Rustam, native name zibad -al-barriya, 25.4.33, *Yussef Lazar* 3914.

L. suworowii (*Kuntze*) *Regel.*

Rustam, 19.4.31, *Yussef Lazar* 1171A, 1172 ; Baghdad, in gardens, native name ward dhail-al-bazzun, 29.4.33, *do.* 3900.

The species is a native of W. Turkestan: these specimens are presumably cultivated or escapes from cultivation.

Plumbago europaea *L.*

Rowanduz Gorge (Kurdistan), 600 m., 12.10.31, 455 ; Dohuk (Kurdistan), 450 m., on a cliff face, 10.10.31, 1585; Rowanduz Gorge, 600 m., on the stony hillside, fls. mauvish-white, 25.7.32, 2982 ; Dohuk, Kurdistan, 450 m., 25.7.33, 3702.

PRIMULACEAE

Anagallis arvensis *L.* subsp. **phoenicea** (*Scop.*) *Schinz et Keller* var. **coerulea** *Lüdi* see Marsden-Jones and Weiss in Proc. Linn. Soc. **150,** 146–155 (1938).

Rustam, common in cultivated fields, 15.3.31, 373 ; Baghdad, common in cultivated fields and gardens, blue fls., native name rumaiminah, 15.3.31, 1108 ; Daltawa, in cornfields, eaten by sheep young but the fruit is bad for them, native name rumaiminah, 29.4.32, *Darwish Haidari* 2471A; Bada (N. of Baghdad), native name rumaiminah, 26.5.32, 2497 ; Baghdad, in fields at Hinaidi and Rustam, 25.3.33, *Yussef Lazar* 3919 ; Makhlat, 180 m., on open *Stipa* steppe, 29.4.33, 4254 ; Ghurfa Plain (nr. Daltawa), in a depression previously cultivated, 12.4.33, *Guest, Eig and Zohary* 5076.

Androsace maxima *L.*

Altun Kupri—Gowair (on top of a "tel"=ancient rubbish mound), Mar. 30, 380; nr. Arbil (on top of a "tel"), 27.3.30, 629; Dohuk—Mosul, 300–450 m., in cultivated fields, 1.4.31, 1325 ; Mosul, on a hill, 23.4.32, *Yussef Lazar* 3383 ; Ain Ghazal (Mosul Province), 360 m., in a field, 28.4.33, 4089 ; Balad Sinjar–Tal Afar, 330 m., 28.4.33, 4173 ; Ain-al-Husan (nr. Sinjar), 315 m., on open *Poa* steppe, 28.4.33, 4230.

Primula algida *Adam* var. **sibirica** (*Ledeb.*) *Pax* f. **colorata** *Regel*, see Pax in Pflanzenr. **4,** 237, Primulac. p. 73 (1905).

Arl Gird Dagh, 3600 m., on a grassy ledge on a cliff, only one specimen found, 22.7.32, 2876.

P. auriculata *Lam.*

Arl Girt Lake (Kurdistan), 3000 m. down to 1800 m., plants smaller at higher altitudes and larger lower down, Aug. 31, *Ludlow-Hewitt* 1503 ; Chia-i-Mandali (nr. Walza), 2100 m., in wet places on marshy turf, 18.7.32, 2687 ; Arl Gird Dagh, 3000 m., on wet grassy places by a lake, "primrose pink" fls., 22.7.32, *Guest and Ludlow-Hewitt* 2875.

P. bornmulleri *Pax.*

Rowanduz Gorge, 450 m., on a cliff face in a narrow gorge by the stream, 20.4.32, 2139.

I am indebted to Prof. Dr. O. Schwarz, Herbarium Haussknecht, Weimar, for the opportunity to examine the type specimens of this species.

Oleaceae

Fraxinus aff. **oxycarpae** Willd.

Bursorini Gorge (Kurdistan), 750 m., 12.10.31, 460 ; Shaqlawa, Kurdistan, 23.3.30, 566.

460 shows only leaves ; 566 has only flowers.

F. syriaca Boiss.

Walash to Nawanda, 1040 m., by a stream in the valley, 20.7.32, 2750 ; Shaikh Adi, 750 m., by the stream, tree, 14.7.33, 3663.

F. aff. **syriacae** *Boiss.*

Rowanduz Gorge (Kurdistan), 600 m., 12.1.31, 483.

Some of the leaflets are ovate–oblong.

F. aff. **rotundifoliae** *Mill.*

Bursorini Gorge (Kurdistan), 750 m., near the stream, 12.10.31, 461. The leaflets are up to 5.5 cm. long, 4 cm. wide. There is no fruit.

The view of the species of *Fraxinus* followed here is that taken in Rehder's Manual of Cult. Trees and Shrubs, 1940.

Olea europaea *L.*

Shaikh Adi (N. of Mosul), 825 m., native name zaitun, olive is extensively cultivated near villages, 10.10.31, 1645.

Jasminum azoricum *L.*

Garden at Basra, Oct. 29, 283.

Apocynaceae

Apocynum venetum *L.* var. **longifolium** *Bég et Belos.* in Rev.Mon. Gen. Apocynum 71 (1913).

Atrush (N. of Mosul), 900 m., pink fls., on red marl banks (by water), 13.7.33, 3653.

Vinca libanotica *Zucc.*

Bazian Pass, up to about 900 m., 31.3.32, *Ludlow-Hewitt* 1923 ; Sulaimaniya, 750 m., 1.4.32, *do.* 1940.

Asclepiadaceae

Cynanchum acutum *L.*

Rustam and Dabouni near Kut, Sept. 29, 192 ; Rustam, along channels, growing over bushes, etc., native name halablab, 23.9.32, *Yussef Lazar* 3497 ; do., in a vegetable channels, 29.10.32, 3590.

Marsdenia erecta (*L.*) *R. Br.*

Rowanduz Gorge (Kurdistan), 750 m., low tufted bush growing in many places on the mountain side which appeared to have been eaten back almost to the ground by sheep (?) or passing donkeys. etc., 12.10.31, 499 ; do., 600 m., on the mountain side, 25.7.32, 2976.

Vincetoxicum tmoleum *Boiss.*

Seri Hassan Beg, 1800 m., in the stony bed of a stream, small erect shrub, 24.7.32, 2900.

GENTIANACEAE

Centaurium tenuiflorum (*Hoffmgg. et Link*) *Fritsch.*

Rustam, near gardens, possible escape from cultivation, 2.6.31, *Yussef Lazar* 1186 ; Daltawa, May 32, 2453 ; Baghdad, in fields at Rustam, 18.5.33, *Yussef Lazar* 3923.

The distinction between this species and *C. pulchellum* (Swartz) Druce does not seem to be very clear in Oriental material. These specimens are included under *C. tenuiflorum*, mainly because they generally bear 5–9 pairs of leaves on the main stem [cf. Wheldon and Jackson in Journ. Bot. **63,** 345–352 (1925), and Gilmour in Kew Bull. 497–502 (1937)].

C. turcicum (*Vel.*) *Ronn.*

Arl Gird Dagh, 1800 m., by a stream, 21.7.32, 2822.

Gentiana olivieri *Griseb.*

Almost certainly collected near Mosul or Kirkuk, 147 ; nr. Kirkuk, on the road to Baba Gurgur oil wells in light sandy soil, 300 m., 4.4.31, 1357 ; Nisibin, 28.4.31, *Ludlow-Hewitt* 1540 ; Zawita Gorge, 900 m., on high sloping rocky ledges above the gorge, 23.4.32, 2194 ; Zakho Pass, 750 m., 25.4.32, 2268 ; nr. Amadia, native name mamiran (K.), 1932, *Majid Mustafa* 3605 ; Balikian (nr. Diana and Rowanduz), Kurdistan, 600 m., 10.5.33, *Cuckney* 3831 ; Zawita, 990 m., in small rocky ravine, 30.7.33, 4775 ; do., 1230 m., in open oak forest, 30.7.33, 4850.

G. septemfida *Pall.* var. **cordifolia** (*C. Koch*) *Boiss.*

Upper Alamut Valley, Persia, 2400–3300 m., by water, August 31, *Stark* 1601.

This specimen has a pedicel 14 mm. long.

G. verna *L.* var. **obtusifolia** *Boiss.*

Arl Girt, 3000–3300 m., Aug. 31, *Ludlow-Hewitt* 1520.

Nymphoides indicum (*L.*) *O. Kuntze.*

Amara marshes, common the surface of the water, 13.12.31, 1622.

BORAGINACEAE

Alkanna hirsutissima *DC.*

Mosul, on a hill, native name khuzaimah, 20.4.32, *Yussef Lazar* 3362 , Ain-al-Husan (nr. Sinjar), 315 m., on open *Poa* steppe, 28.4.33, 4196.

A. kotschyana *DC.*

Zawita Gorge, 900 m., on high rocky ledges above the gorge, fl. orange yellow, 23.4.32, 2204 ; Zakho Valley, 600 m., on rocks, 25.4.32, 2262 ; Atrush, 795 m., on limestone cliffs, 12.7.33, 3625.

Anchusa aucheri *DC.*

Amadia, 1050 m., dry well-drained slopes of the valley, 31.3.31, 1443.

A. hispida *Forssk.*

Southern desert, W. of Zubair, on compact sandy soil covered by small stones and grit, 8.4.33, *Guest, Eig and Zohary* 5030.

A. italica *Retz.*

Kirkuk, 240 m., in a cornfield, 16.4.32, 536A ; Mosul, 270 m., in cultivated fields, 2.4.31, 1337, 1490 ; Tal Kaif, c. 300–600 m., useful for sheep grazing when young, native name lisan-ath-thor, Apr. May 1932, *Mudir of Tal Kaif* 3202 ; Mosul, in a wheatfield, native name sambasma', 14.4.32, *Yussef Lazar* 3363.

A. italica *Retz.* var. **kurdica** *Gusul.* in Bul. Fac. Stiinte **1,** 274 (1927) et Fedde Rep. Sp. Nov. **26,** 308 (1929).

Nr. Kirkuk, 300 m., on the road to Baba Gurgur oil wells, 4.4.31, 1354 ; Dohuk (Kurdistan), 450 m., on rocks, 10.10.31, 1588 ; Mandali, in cornfields, leaf used for making a decoction which is given to babies, native name lisan-ath-thor, 26.3.32, 1717 ; Naft Khana, 150 m., 29.3.32, 1849 ; Balad Sinjar–Tal Afar, 330 m., on semi-natural steppe, 28.4.33, 4179 ; Kani Dolman hills, 390 m., on dry stony rounded hilltop, 30.4.33, 4286 ; Jabal Hamrin (nr. Table Mt.), 150 m., on sandy ledges, brilliant borage-blue fls., 28.3.32, 1811 ; Kirkuk Province, useful grazing plant, native name hamham, 13.5.33, *Ali Effendi Hadari* 3932 ; Ain Ghazal (Mosul Province), 3600 m., in a field, 28.4.33, 4069 ; Ain-al-Husan (nr. Sinjar), 315 m., on open *Poa* steppe, 4210.

Gusuleac regards this as possibly the hybrid between *A. italica* and *A. strigosa.*

A. italica *Retz* var. **macrocarpa** (*Boiss. et Hoh.*) *Gusul.* l.c.

Zawita, 900 m., waste land by gardens, native name kuzrik (K.), 27.7.33, 3743.

A. neglecta *DC.*

Jabal Rus, on waste lands, eaten by sheep and donkeys, 14.5.31, *Mudir of Gilli* 3151.

A. strigosa *Labill.*

Zawita Gorge, 900 m., on wide rocky ledges, pink variety, 23.4.32, 2189 ; do., ordinary blue variety, 2190 ; Jabal Hamrin nr. Table Mt., 150 m., on dry sandy soil, 15.4.32, 2621.

Arnebia decumbens (*Vent.*) *Coss et Kral.* (*A. cornuta* Ledeb.).

Jabal Hamrin, 26.3.30, 682 ; nr. Kirkuk, on the road to Baba Gurgur oil wells, 300 m., 4.4.31, 1363 ; Tuz, 210 m., in cultivated fields, 6.4.31, 1394 ; Babylon, in depressions among the ruins, 23.3.32, 1683 ; Jabal Darawishka (nr. Khanaqin), 240 m., on stony hillside, 28.3.32, 1788; Qaraghan, on stony ground, 30.3.32, 1878 ; Mosul, on the hill of Nineveh, native name khuzaimah, 15.4.32, *Yussef Lazar* 3361 ; Jazira Desert, 20.4.33, 3825 ; Southern desert, W. of Zubair, compact sandy soil covered by small stones and grit, *Guest, Eig and Zohary* 5017 ; Chuwaiba Wells, nr. Zubair, on sandy soil in a slight depression, 8.4.33, 5050.

A. linearifolia *DC.*

Chuwaiba Wells, nr. Zubair, on sandy soil in a depression, 8.4.33, *Guest, Eig and Zohary* 5049.

Asperugo procumbens *L.*

Baghdad, in grassy places round date plams at Karada, flower blue, Mar. 31, 1117 ; Amadia, 1020 m., in fields, damp places under walls, between rocks, etc., fls. blue, 26.3.31, 1217.

Caccinia crassifolia (*Vent.*) *O. Kze.* (*C. glauca* Savi).

Jabal Hamrin (nr. Table Mt.), 150 m., on sandy soil, 30.3.32, 1896.

Cordia myxa *L.*

Basra, Oct. 29, 281.

Cynoglossum creticum *Mill.* (*C. pictum* Ait.).

Shaqlawa, 840 m., in fruit orchard under shade of walnut tree, 17.7.32, 3012 ; Dohuk, in a peach orchard, native name nashka (K.), 26.4.32, 3347.

Echium italicum *L.*

Ba'adhara (nr. Shaikhan), on hilly ground, good fodder plant also used as a remedy for snake bite, kuriz (K.), 19.6.32, *Salim Effendi* 2593 ; Arl Gird Dagh, 1200 m., on the hillside, 20.7.32, 2780 ; Atrush 900 m., on stony hillside, 13.7.33, 3642 ; Zawita, 900 m., on old abandoned vineyard, 1.8.33, 4895.

4895 shows leaves only and is doubtfully named.

Ehretia aff. **thyrsiflorae** (*Sieb. et Zucc.*) *Nakai.*

Basra, Apr. 31, Dowson 1556 [presumably cultivated].

This specimen shows no fruit or two-year-old wood nor is there any information on whether the leaves are evergreen or deciduous. It cannot, therefore, be run down in Nakai's key (Journ. Am. Arb. **5,** 36–41 (1924)).

Heliotropium bovei *Boiss.*

Kirkuk Province, useful grazing plant, native name naîmah, 14.5.33, *Ali Effendi Hadari* 3936.

H. bovei Boiss. var. **bornmulleri** *Nábělek* e descr. in Publ. Fac. Sci. Univ. Masar. **70,** 16 (1926).

Ba'adara (nr. Shaikhan), on high ground, native name kia bar ruzh hor (K.), 19.6.32, *Salim Effendi* 2600.

H. circinnatum *Griseb.*

Dohuk, 410 m., 10.10.31, 1664.

H. ramosissimum (*Lehm.*) *DC.* (*H. undulatum* Vahl var. *ramosissimum* Lehm., *H. persicum* Lam. sec. Boiss.).

Zubair (Basra), on sandy desert on 'Iraq–Nejd frontier, spring fodder plant, native name rim-ram, 4.5.32, *Abdul Wahab Mustafa* 3158 ; Ghurfa plain, 7.7.33, 3999 ; Chuwaiba Wells, nr. Zubair, on sandy soil in a slight depression, 8.4.33, *Guest, Eig and Zohary* 5051.

H. europoeum *L.* var. **tenuiflorum** *Guss.* Fl. Sic. Syn. **1,** 212 (1842–3).

Nr. Rustam, Aug. 29, 158 ; Kut, Sept. 29, 199 ; Rustam, 2.6.31, *Yussef Lazar* 1190 ; nr. Mahmudiya–Latifiya Estate, native name zurraij, 16.5.32, 2391 ; Bada (N. of Baghdad), on sandy loam in vegetable garden, native name zurraij, 26.5.32, 2498 ; Hit, in a date garden, native name zurraij, 15.10.32, 3529 ; Zawita, 900 m., in gardens, native name buhnshînk (K.), 27.7.33, 3755.

H. noëanum *Boiss.*

Rowanduz Gorge (Kurdistan), 750 m., 12.11.31, 1538 ; Khanzad Pass (nr. Arbil), 690 m., on stony hilltop, 17.7.32, 3005 ; Seri Hassan Beg, 1500 m., on the hillside, 24.7.32, 3039.

The nutlets in this species are pubescent, not glabrous as stated by Boissier (Fl. Or. **4,** 128 (1875)).

H. suaveolens *M.B.*

Hatra, among the ruins, native name zurraij, 17.10.32, 3559.

H. supinum *L.*

Nasiriya, in irrigated fields, grazed by all livestock which get fat on it according to the local herds, native name ini'mah, 16.5.32, *Abd-ar-rizaq Barbuti* 2540 ; Hussainiya (Kut), in a ploughed field, native name wasanabah (?), 16.9.32, *Yussef Lazar* 3480 ; Diyala River at Rustam, on banks of river by high water mark, flat spreading habit, 24.9.32, 3512 ; Aziziya, in a *Sorghum* field, 6.10.32, 3571 ; Rustam, in a vegetable plot, native name satih, 31.10.32, 3587.

Lappula echinophora (*Pall.*) *O. Kunzte* (*Echinospermum szovitzianum* F. et M.).

Jabal Hamrin nr. Table Mt., 22.2.31, *Ludlow-Hewitt* 1073 ; Dohuk, 450 m., in fields on dry gravel soil, fl. blue, 1.4.31, 1305 ; nr. Kirkuk, 300 m., on the road to Baba Gurgur oil wells (sandy soil), 4.4.31, 1360 ; Jabal Hamrin (nr. Table Mt.), 150 m., on dry sandy soil, 28.3.32, 1900 ; Dohuk, 450 m., on dry edge of a cornfield, stony ground, 25.4.32, 2295.

L. sessiliflora (*Boiss.*) *Gürke* (*Echinospermum sessiflora* Boiss.)

Balad Sinjar, 402 m., on roadside grazing strip, fls. bright blue, 28.4.33, 4113.

L. spinocarpos (*Forsk.*) *Aschers.* (*Echinospermum spinocarpos* (Forsk.) Boiss.).

Hinaidi, on channels, 30.3.31, *Yussef Lazar* 1155 ; Baghdad, fields at Rustam, 25.4.33, *do.* 3885 ; Kani Dolman hills, Kirkuk, 390 m., 30.4.33, 4343.

L. callosum *Vahl.*

Southern desert, W. of Zubair, on compact sandy soil covered by small stones and grit, 8.4.33, *Guest, Eig and Zohary* 5029 ; Chuwaiba Wells, nr. Zubair, on sandy soil in a slight depression, 8.4.33, *Guest, Eig and Zohary* 5048.

L. tenuiflorum *L. fil.*

Dohuk, 550 m., in a cultivated field on dry gravel soil, 2.4.31, 1308 ; Balad Sinjar, 402 m., on roadside grazing strip, 28.4.33, 4126 ; Kani

Dolman hills, Kirkuk, 390 m., on dry stony rounded hilltop, 30.4.33, 4323.

Moltkia angustifolia *DC.*

Shargat, Apr. 20, *Y. Ramchandra Rao* 120.

Myosotis alpestris *Schm.* var. **demawendica** *Bornm.* (det. A. E. Wade).

Arl Gird Dagh, 3000–3300 m., on the mountain side, 22.7.32, 2833 ; Siah Koh (Kurdistan), 3000 m., hillside covered with lumps of green, literally hidden by brilliant light blue fls., Aug. 31, *Ludlow-Hewitt* 1513 ; Arl Gird Dagh, 3300–3600 m., common in grassy places on rocky ledges, brilliant blue fls., 22.7.32, 3072.

M. caespitosa *K. F. Schultz* (det. A. E. Wade).

Seri Hassan Beg (Rowanduz Area), 1800 m., in a ditch in a corn field, 25.7.32, 3022.

M. hispida *Schlecht.* var. **grandiflora** *Boiss. et Heldr.* Diagn. **1,** 11, p. 123 (1849) (det. A. E. Wade).

Jindian, nr Rowanduz, 600 m., damp situation by Sayyid Taha's cave, 18.4.32, 2040.

M. sylvatica (*Ehrh.*) *Hoffm.* (det. A. E. Wade).

Chia-i-Mandali (nr. Walza), 2250 m., by a stream, 19.7.32, 2731 ; Arl Gird Dagh, 2550 m., by a spring, 24.7.33, 2954.

Nonnea melanocarpa *Boiss.*

Mandali, cultivated fields, 10.5.30, 883 ; nr. Kirkuk, on the road to Baba Gurgur oil wells, 300 m., sandy soil, 4.4.31, 1365.

Boissier's description of the corolla scales of this species as "velutinae" (Fl. Or. **4,** 166 (1879)) is somewhat misleading. The scales often bear tufts of hair longer than the scales themselves.

Bornmüller regards this as a synonym of *N. picta* (M.B.) F. et M. (in Beih. Bot. Centralb. **61,** B, 92 (1941)). A view which may well be correct.

N. pulmonarioides *Boiss. et Bal.*

Arl Gird Dagh, 3000 m., among rocks by a lake, 22.7.32, *Guest and Ludlow-Hewitt* 2861, 2863A.

These specimens match "Helgurd, ditionis Riwandous, 26.6.1893, *Bornmuller* 1629". Bornmüller's specimen does not show any fruit.

The nutlet in 2861 is pubescent, not glabrous, as in Boissier's description. The Transcaucasian *N. intermedia* Ledeb. is described by Boissier as differing from *N. pulmonarioides* in the leaves being semi-amplexicaul, the calyx lanceolate and the nuculus pubescent. *N. intermedia* is represented at Kew by "Georgia, in jugo Adzharico, prope pagum Bachmaro, 16.7.25, *Grosshiem*". This specimen does not bear any fruit, but the distinction in the calyx and leaves is not great. *N. pulmonarioides* may, therefore, be only a synonym of *N. intermedia*, but it is kept as a separate species here, since no authenticated material of the latter has been seen.

Onosma albo-roseum *Fisch. et Mey.*

Amadia, c. 1200 m., on rocks, fls. pink, native name mishmaizhūk, 26.3.31, 1241 ; do., 600–1500 m., common all over the hills, Apr. 31, *Ludlow-Hewitt* 1502 ; Bazian Pass, Kurdistan, 375 m., 1.4.32, *do.* 1195 ; Zawita Gorge, 900 m., on rocky ledge, pink, white and red fls., 23.4.32, 2193.

O. aff. **albo-roseo** *Fisch. et Mey.*

Zawita Valley, 885 m., on stony slope, 25.7.33, 4444 ; Zawita Gorge 780 m., limestone rocks, 26.7.33, 4468 ; Zawita, 1020 m., in pine forest, 30.7.33, 4830 ; do., 982 m., in oak forest on rocky slope, 1.8.33, 4904 ; do., 1035 m., on steep limestone slope, 1.8.33, 4925.

These specimens have no fruits nor flowers. Both these series of specimens, as well as other specimens from 'Iraq and Kurdistan in the Kew Herbarium, show rather more strigose leaves than in much of the material of the species from elsewhere.

O. dichroanthum *Boiss.*

Mosul, 270 m., 2.4.31, 1390A ; Tuz, in cultivated fields, 6.4.31, 1405 ; Qosh Tapa (nr. Arbil), 405 m., in cultivated fields, 2.4.31, 1479.

O. nemoricolum *Haussk. et Bornm.*

Rowanduz Gorge, c. 600 m., on the mountain side, 17.4.31, 2037 ; do., *Ludlow-Hewitt* 2037A.

O. rascheyanum *Boiss.*

Chia-i-Mandali, 2400–2700 m., on the rocky mountain side, 19.7.32, 2728.

O. rostellatum *Lehm.*

Zawita Gorge, 840 m., on rocks, 26.7.33, 3714 ; do., 1065, in oak forest, 1.8.33, 4940.

O. sericeum *Willd.* (*O. flavum* (Lehm.) Vatke).

Penjwyn, in the mountains, 26.6.32, *Khalil Feddo* 3446 ; Atrush (N. of Mosul), Kurdistan, 795 m., at base of limestone cliff, 12.7.33, 3622 ; do., 885 m., on red marl banks in open pine forest, 13.7.33, 4388.

Paracaryum sintenisii *Haussk.*

Zawita Gorge, 900 m., on high rocky ledges above the gorge, 23.4.32, 2199 ; Zakho Pass, 750 m., 25.4.32, 2261.

Podonosma syriacum (*Labill.*) *Boiss.*

Zawita Gorge, 900 m., on rocks, fls. bluish or pale blue, 23.4.32, 2182, 2224.

Rindera lanata (*Lam.*) *Bunge* var. **pumila** *Kusnz.* in Trav. Mus. Bot. Acad. Imp. Sci. St. Petersb. **7,** 46 (1910).

Jabal E.N.E. of Seri Hassan Beg, 1800 m., on the stony mountain side, 24.7.32, 2909.

Solenanthus petiolaris *DC.*

Amadia, 1020 m., on a bank of deep earth near a stream in the valley (shady damp situation), 26.3.31, 1236.

Symphytum kurdicum *Boiss. et Haussk.*

Bursorini Gorge (nr. Rowanduz), 600 m., on the mountain-side under trees, stones, etc., 17.4.32, 2038.

CONVOLVULACEAE

Convolvulus arvensis *L.*

Nr. Baghdad, July 29, 176 ; Mandali, 10.5.30, 887 ; Rustam, 16.5.31, *Yussef Lazar* 1170 ; Seri Hassan Beg (Rowanduz Area), 1500 m., by a stream, 25.7.32, 3037.

[**C. cantabrica** *L.*

Kowait, delicate pink, 20.3.32, *Young* 1687.]

C. hirsutus *Stev.*

Dohuk–Zakho, 450 m., in a cornfield, 24.4.32, 2236.

C. oxyphyllus *Boiss.*

Makatu nr. Mandali, May 30, 868 ; Baba Gurgur, nr. Kirkuk, 300 m., alluvial knole on sandstone bluff, 8.7.33, 4016, 4017 ; nr. Altun Kopri on River Zab, Bakhtiari conglomerate hills, 8.7.33, 4020 ; Southern desert, W. of Zubair, on compact sandy soil, covered by small stones and grit, 8.4.33, *Guest, Eig and Zohary* 5028.

5028 is without fls. and may possibly be *C. lanatus* Vahl.

C. pilosellaefolius *Desr.*

Baghdad, July 29, 190 ; almost certainly collected near Mosul or Kirkuk, 267A ; Rustam, in fields, native name madaid, 2.5.31, *Yussef Lazar* 1169 ; Daltawa, in cornfields, native name madaid, 29.4.32, *Darwish Hadari* 2344 ; do., 26.5.32, 2432 ; do., in an onion field, native name madaid or halablab, 26.5.32, 2475 ; Hussainiya (Kut), in a ploughed field, native name madaid, in a ploughed field, 16.9.32, *Yussef Lazar* 3492 ; Haditha, in a field of millet, native name rishih, 15.10.32, 3522 ; Kirkuk Province, excellent fodder plant, native name madaid, 13.5.33, *Ali Effendi Hadari* 3928.

C. stachydifolius *Choisy.*

Mandali, 9.5.30, 791 ; Kirkuk, 210 m., in cultivated fields, colour a delicate purplish pink, 4.4.31, 1376 ; Arbil, 360 m., in cultivated fields, 2.4.31, 1467 ; Mandali, in cornfields, rich pink, native name madaid or lulu, 26.3.32, 1809 ; Mosul, in wheat fields, native name mudaid, 10.4.32, *Yussef Lazar* 3357 ; Ain Ghazal (Mosul Province), 360 m., in a field, 28.4.33, 4059.

C. reticulatus *Choisy.*

Makatu nr. Mandali, a plant with a long woody rootstock, 11.5.30, 880 ; Khanzad Pass, 690 m., on the stony hilltop, 17.7.32, 3007 ; nr. Ain Sifni, 450 m., stony hillside pastures, prostrate spreading herb with white fls., 12.7.33, 4044 ; Kani Dolman hills, Kirkuk, 390 m., on dry stony rounded hilltop, 30.4.33, 4289, 4370.

Convolvulus sp.

Balad Sinjar–Tal Afar, 330 m., on roadside strip of waste land, 28.4.33, 4149.

Cressa cretica *L.*

Kut, Sept. 29, 193 ; Daltawa, on salty land, native name shuwail, 26.5.32, 2631 ; in the Jazira (Wadi Tharthar), on saline land by a sulphurous spring, 15.10.32, 3541 ; by Habbaniya lake, on the shore of the lake (saline land), 15.10.32, 3542.

Cuscuta approximata *Bab.*

Arl Gird Dagh (nr. Nawanda), 1800 m., by a stream, parasitic on *Equisetum* sp. and on clover, 21.7.32, 2865.

Cuscuta babylonica *Auch.* (*C. viticis* Hand.–Mazz.).

Seri Hassan Beg, 750 m., parasitic on *Vitex agnus-castus* L., 24.7.32, 3043.

C. kurdica *Engelmann.*

Chia-i-Mandali (nr. Walza), 2100 m., on the mountain side, on *Eryngium billardieri* Laroche subsp. *nigromontanum* (Boiss. et Buhse) Wolff and *Campanula syspirensis* C. Koch, 18.7.32, 2688 ; do., 2700 m., among rocks on top of the ridge, on *Galium kurdicum* Boiss. et Hoh., 19.7.32, 2697 ; Arl Gird Dagh, 2700 m., parasitic on *Cousinia* sp., red, 24.7.32, 2947.

The scales in these specimens are very thin and difficult to see.

C. lehmanniana *Bunge.*

Rustam, parasitic on *Populus euphratica*, kills of large patches of the upper growth in riverside thickets of Euphrates poplar, native name halablab, 24.9.32, 3498 ; Zawita, 1330 m., on the mountain side [on *Quercus* sp.], 30.7.33, 4869.

The typical form of this species is confined to Central Asia although var. *esquamata* Engelmann occurs in Persia. Our plants show corollas 4–6 mm. long and scales reaching the base of the anthers as described and figured by Yuncker (in Mem. Torr. Bot. Club **18,** 257–9) for the typical form. *C. monogyna* Vahl, a widespread plant in the Orient, has fls. 3–4 mm. long and the scales scarcely reaching the base of the anthers.

C. paniflora *Ten.*

Kani Dolman hills, Kirkuk, 390 m., on dry stony rounded hilltop, parasitic on *Onobrychis* aff. *squarrosa* Viv., 30.4.33, 4357 ; do., on an Umbellifer, 4373 ; Zawita, 1230 m., on the mountain side, parasitic on *Teucrium chamaedrys* L., 30.7.33, 4868A, 4869A.

Solanaceae

Datura metel *L.* (*D. fastuosa* L.).

Basra, cultivated in gardens (probably not indigenous), 15.12.31, 1610.

D. metel is the earliest name : see Safford in Ann. Rep. Smithson. Inst. 537 (1920) ; Journ. Washington Acad. Sci. **11,** 178 (1921) ; Journ. Hered. **12,** 178–190 (1921).

D. stramonium *L.*

Ain Sifni (N. of Mosul), growing wild on the edge of a vegetable patch, escape from cultivation ? or indigenous ?, 10.10.32, 1652.

Hyoscyamus albus *L.*

Arl Gird Dagh, 1800 m., on flat bare soil between rocks, fls.white ? 24.7.32, *Guest and Ludlow-Hewitt* 2953 ; Shaikh Adi (N. of Mosul), 900 m., yellow fls., 14.7.33, 3673.

H. senecionis *Willd.*

Zawita, 990 m., on rocky cliff nr. the village, 30.7.33, 4837. The leaves are broader and less divided than is usual in the species.

H. reticulatus *L.*

Arbil, 27.3.30, 620 ; Mosul, c. 240 m., 2.4.31, 1338 ; Kirkuk, 240 m., in cultivated fields, 4.4.31, 1378 ; Kirkuk, 240 m., in a cornfield, 16.4.32, 2003 ; nr. Dohuk, in a cornfield, 24.4.32, 2234 ; Mosul, in a wheat field, native name binj, 15.4.32, *Yussef Lazar* 3364 ; Ain Ghazal (Mosul Province), 360 m., in a field, 28.4.33, 4082.

In Pojarkova's key to this group of *Hyoscyamus* in Journ. Bot. URSS **27,** 129 (1942), these specimens come down to *H. reticulatus* or *H. kotschyanus* Pojark. I am unable to see any specific distinction between these two species, although specimens of both cited by Pojarkova have been examined.

Lycium barbarum *L.*

Baghdad, in a thicket of Euphrates poplar at Karada, blueish-yellow fls., Mar. 31, 1126 ; Babylon, common among the ruins and in the locality, native name sarim or ausaj, low thorny shrub, 23.3.32, 1684 ; Qaraghan, on dry mud flats by the Diyala River, 30.3.32, 1877 ; Daltawa, along channels, a shrub 2–3 ft. high, the young green leaves are cooked as a vegetable, the old dry thorny stems are placed on top of mud walls as fencing, 29.4.32, *Darwish Hadari* 2633 ; in the Jazira, nr. the Wadi Tharthar, native name ausaj, 15.10.32, 3556.

2633, 3556 show no fls., but probably belong to this species.

Nicotiana glauca *R. Graham.*

Hilla, in a garden, ornamental trees about 15 ft. high, 15.4.32, 3168.

N. tabacum *L.*

Zawita, 900 m., cultivated tobacco, 10.10.31, 1607.

Solanum luteum *Mill.* (*S. villosum* (L.) Lam.).

Nr. Dohuk, 600 m., fruit is eaten, 10.10.31, 1608.

Scrophulariaceae

Antirrhinum ceratotheca *Náběl*ek e descr.

Baba Gurgur, nr. Kirkuk, 260 m., on gypsum outcrop, 1.5.33, 4384.

Celsia heterophylla *Desf.* (det. Murbeck 1936).

Rowanduz Gorge, 740 m., by a waterfall on stony ground, fls. yellow, 17.7.32, 2991.

C. lanceolata *Vent.* (det. Murbeck 1936).

Jabal Hamrin (nr. Injana), 29.3.30, 689 ; Jazira Desert, Mar.–Apr. 33, *Edmonds* 3797 ; Ain-al-Husan (nr. Sinjar), 315 m., on open steppe (*Poa*),

28.4.33, 4194 ; Ghurfa Plain (nr. Injana), on sandy soil, 12.4.33, *Guest, Eig and Zohary* 5079.

Celsia sp. ? (det. Murbeck 1936).

Mahad (nr. Shaikhan), good fodder plant, used also by the Kurds as a specific against worms, native name qabil (K.), 23.6.32, *Salim Effendi* 2606.

Material inadequate for identification.

Linaria chalepensis (*L.*) *Mill.*

Mosul–Dohuk, 300–450 m., in cultivated fields, fls. white, 1.4.31, 1285 ; Qosh Tapa (nr. Arbil), 405 m., in cultivated fields, 2.4.31, 1471 ; Qizil Robat, in a cornfield, 23.3.32, 1769.

L. elatine (*L.*) *Mill.* var. **lasiopoda** *Vis.* Fl. Dalm. **2,** 161 (1847) (var. *villosa* Boiss.).

Nr. Mahmudiya (Latifiya Estate), on outside of channels among lucerne plots, 16.5.32, 2392 ; Daltawa, in a cornfield, 26.5.32, 2446 ; Bada (N. of Baghdad), in a vegetable garden on sandy loam, native name na'aim, 26.5.32, 2507 ; Seri Hassan Beg, 1500 m., on the hillside, 24.7.32, 3042.

L. genistifolia (*L.*) *Mill.*

Arl Gird Dagh, 2700 m., among rocks by a lake, 24.7.32, 2959 ; Chia-i-Mandali (nr. Walza), 2100 m., among rocks, 18.7.32, 2683.

L. micrantha (*Cav.*) *Hoffm. et Link.*

Ain Ghazal (Mosul Province), in a field, 28.4.33, 4091 ; Kani Dolman hills, Kirkuk, 390 m., dry stony rounded hill top, 30.4.33, 4306.

L. persica *Chav.*

Dohuk, 450 m., cultivated fields, 1.4.31, 1283.

Odontites aucheri *Boiss.*

Chia-i-Mandali (nr. Walza), 1500–1800 m., on the stony hillside, 18.7.32, 2701.

Onosma froedinii *Rech. fil.*

Chia-i-Mandali (nr. Walza), 2100 m., among rocks under a cliff, fls. yellow, 18.7.32, 2678 ; Arl Gird Dagh, 1950 m., on rocky mountain side, fls. yellow, 24.7.32, *Guest and Ludlow-Hewitt* 2918.

On comparing these with the type of *O. froedinii* on loan by courtesy of the Botaniska Institutionen, Uppsala, 2918 is seen to be a lower-growing plant, and 2678 has larger cauline leaves. Since considerable variation in stature and leafiness of the stem also occurs in *O. sericeum*, these two specimens are considered conspecific with *O. froedinii*.

Parentucellia latifolia (*L.*) *Car.* (*Euphrasia latifolia* L., *Eufragia latifolia* (L.) Griseb., *Bartsia latifolia* (L.) Car.).

Makhlat, 180 m., on open *Stipa* steppe, 29.4.33, 4250.

Pedicularis caucasica *M.B.*

Siah Koh (Kurdistan), 3300 m., fls. yellowy mauve, Aug. 31, *Ludlow-Hewitt* 1531 ; Arl Gird Dagh, 3300 m., on rocks, 22.7.32, 3063.

Although the corolla tube is about twice as long as the calyx, the filaments are sparsely hairy. This specimen has therefore been named *P. caucasica* rather than *P. cadmea* Boiss. There is some doubt if the latter is specifically distinct.

P. comosa *L.*

Siah Koh (Kurdistan), 3300 m., fls. yellowy mauve, Aug. 31, *Ludlow-Hewitt* 1531A.

A depauperate specimen only 5 cm. high.

These two species of *Pedicularis* were collected together under the same number ; the note on flower-colour may refer to either species.

Rhynchocorys elephas (*L.*) *Griseb.*

Arl Gird Dagh, 2400–2700 m., by a stream, pretty yellow fls., 24.7.32, *Guest and Ludlow-Hewitt* 2941.

This plant does not match the majority of the specimens in the Kew Herbarium. It is glabrescent and has ovate subsessile leaves. It matches however, two gatherings from Lazistan (inter Trebizonde et Baibout, *Monbret* and Djimil, 19.8.1866, *Balansa*). The second of these is cited as *R. elephas* by Boissier Fl. Or. **4,** 478 (1879). Balansa's plants show intermediates between *Guest* 2941 and the commoner hairy form.

R. kurdicus *Nábělek* e descr.

Chia-i-Mandali, 2400 m., 19.7.32, 2853.

Scrophularia deserti *Del.*

Nr. Kirkuk, c. 300 m., on the road to Baba Gurgur oil wells, 4.4.31, 1351A ; Tuz, c. 210 m., in cultivated fields, 6.4.31, 1402 ; Ain-al-Husan (nr. Sinjar), 315 m., on open *Poa* steppe, 28.4.33, 4227 ; Southern desert, W. of Zubair, on compact sandy soil covered by small stones and grit, 8.4.33, *Guest, Eig and Zohary* 5026.

Some of the specimens under 1402 approach very closely to *S. xanthoglossa.*

Scrophularia gracilis *Blakelock* sp. nov. ; a *S. nana* Stiefelhagen indumento minus densiore haud cupuliformi, inflorescentia haud foliosa, corolla majore usque 9 mm. longa (Fig. 4, 532).

Herba nana, perennis, indumento longo stipitato glanduloso-pubescens, 5–15 cm. alta. *Radix* lignosa, crassa, multiceps. *Caules* tenues, erecti, simplices, glanduloso-pubescentes, purpureo-suffusi, c. 1 mm. crassi. *Folia* ovata, lobato-dentata, utrinque glanduloso-pubescentia, griseo-viridia, subcarnosa, dentibus obtusis vel rarius acutis, laminis 0·5–2·7 cm. longis, 0·4–2 cm. latis, petiolis 1–7 mm. longis. *Inflorescentia* glanduloso-pubescens, haud foliosa, bracteis linearibus usque 7 mm. longis, pedicellis 3–5 mm. longis. *Calyx* glanduloso-pubescens ± purpureo-suffusus, lobis ovatis, latiuscule membranaceo-marginatis, c. 1·5 mm. longis, c. 1·5 mm. latis. *Corolla* oblonga, ventricoso-inflata, extra parce glandulosa, 7–8 mm. longa, basi 2–3 mm. lata, medio 3·5–4 mm. lata, apice c. 2 mm. lata, lobis c. 1 mm. longis, superiore parum longiore. *Stamina* inclusa vel subexserta, filamentis glanduloso-pubescentia. *Staminodium* nullum. *Stylus* parce glanduloso-pubescens, c. 7 mm. longus. *Capsula* globosa, glanduloso-pubescens, mucronata, 3 mm. longa, 3 mm. lata.

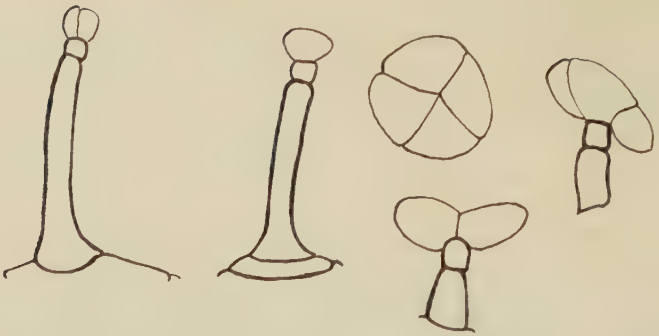

Fig. 4. Glandular hairs of *Scrophularia gracilis* Blakelock (left) ; *S. nana* Stiefelhagen (right).

N. 'Iraq. Jindian nr. Rowanduz, c. 600 m., on cliff face by a spring at Sayyid Taha's cave, 25.3.30, *E. R. Guest* 730 ; do., on rocky cliff wall of Sayyid Taha's cave, damp cool situation above a spring, 18.4.32, *E. R. Guest* 2039 (type).

Our plant differs from *S. farinosa* Boiss. in the stipitate glandular pubescent (not cupuliform) indumentum, the stems more erect, simple and more slender, the leaves generally more obtuse and less lobed and the corolla somewhat larger.

The type specimen of *S. nana* has kindly been sent on loan to Kew by Prof. Dr. O. Schwarz, Herbarium Haussknecht, Weimar.

S. guestii *Eig* in Pal. Journ. Bot. Ser. J. **3,** 80 (1944).

Arl Gird Dagh, 2550 m., by a stream, 24.7.32, 2943 (type collection).

S. aff. **heterophyllae** *Willd.* ?

Baba Gurgur, 360 m., 1.5.33, 4385.

This specimen has obtusely lobed leaves with cuneate bases and long petioles.

S. libanotica *Boiss.*

Amadia, Kurdistan, c. 1500 m., on rocks in Mazurka Gorge, 2.8.33, 3777 ; Ser Amadia, 1800 m., on top of the ridge, 3.8.33, 4991.

S. marginata *Boiss.*

Nr. Injana (Jabal Hamrin) on Ghurfa Plain, on sandy soil, 7.7.33, 4004 ; Baba Gurgur, nr. Kirkuk, 300 m., alluvial knole on sandstone bluff, 8.7.33, 4010.

S. pruinosa *Boiss.* subsp. **iraquensis** *Eig* in Pal. Journ. Bot. Ser. J. **3,** 90 (1944).

Marmarut Mt. (nr. Rowanduz), 1050 m., on a scree, 19.4.32, 2060 (type collection) ; Jabal, E.N.E. on Seri Hassan Beg, 1950 m., 24.7.32, 2920 (type collection).

S. rimarum *Bornm.*

Arl Gird Dagh, 3600 m., on rocks, 22.7.32, 3051.

This has been compared with two specimens kindly lent by Prof. Dr. O. Schwarz, Herbarium, Haussknecht, Weimar. The specimens are " Kurdistania Riwandous (ad fines Pers.) in m. Sakri-Sakran reg. alpina, 13.6.1893, *Bornmuller* 1626 " (type of *S. rimarum* var. *glabrescens* Bornm. in Fedde Rep. Sp. Nov. **7,** 202 (1909)) and " Kurdistania (Assyria orient.), in montis Kuh-Sefin (ditionis Erbil) fissur rup. reg. alp., 1500 m., 21.5. 1893, *Bornmuller* 1625 ". The latter specimen is not cited by Bornmüller, but is either var. *farinea* Bornm. or var. *pubescens* Bornm. from the description. *Guest* 3051 is intermediate in density of indument between var. *glabrescens* and var. *pubescens*.

S. xanthoglossa *Boiss.*

Khanaqin, 210 m., on rocks, 29.3.32, 1841 ; Arbil, 375 m., in a cornfield on red loam, 20.4.32, 2128 ; Dohuk, 450 m., at the edge of a cornfield on stony land, 25.4.32, 2287 ; Mosul, in a wheat field, 9.4.32, *Yussef Lazar* 3393.

S. xanthoglossa *Boiss.*, var. **decipiens** *Boiss.*

Nr. Kirkuk (on the road to Baba Gurgur oil wells), c. 300 m., 4.4.31, 1351 ; Ain Sifni (Mosul Liwa), 450 m., native name kashihat (K.), a poor fodder plant, 9.6.32, *Salim Effendi* 2558 ; Kani Dolman hills, Kirkuk, 390 m., on dry rounded stony hill-top, 30.4.33, 4340 ; cultivated at Kew, from Atrush, 1050 m., Aug. 34, 5002.

S. xanthoglossa *Boiss.* ?

Rowanduz, 26.3.30, 586.

This specimen is intermediate between *S. xanthoglossa* and *S. deserti*. It shows the rounded apices to the leaf-segments of *S. deserti*, but the wider scarious margin to the calyx of *S. xanthoglossa*.

Scrophularia sp.

Chia-i-Mandali, 1500 m., common on the stony hillside, 20.7.32, 2770 ; Atrush, 695 m., base of limestone cliff, 12.7.33, 3628.

These specimens shows fruits but neither leaves or fls.

Verbascum alceoides *Boiss. et Haussk.* (det. Murbeck 1936).

Kani Dolman hills, Kirkuk, 400 m., dry stony rounded hill-top, 30.4.33, 4284 ; nr. Tauq, on flat hillock top, compact soil with few stones, 12.4.33, *Guest, Eig and Zohary* 5093.

V. aleppense *Benth.* (det. Murbeck 1936).

Jabal Hamrin (nr. Injana), 29.3.30, 689A ; Daima (nr. Mandali), in wadi beds, native name simrah or qadimah (K.), 26.3.32, 1713 ; Baba Gurgur, nr. Kirkuk, alluvial knole on sandstone bluff, 8.7.33, 4015 (*V. aleppense* Benth. ? Flores desunt. Murbeck).

V. aureum (*C. Koch*) *Kuntze* (det. Murbeck, 1936).

Chia-i-Mandali (nr. Walza), 1950 m., on the mountain side, 19.7.32, 2720 ; Arl Gird Dagh, 1950 m., on stony mountain side, 24.7.32, 2919 ;

Arl Gird Dagh, 2100 m., on the stony mountain side, 24.7.32, 2931; Jabal E.N.E. of Seri Hassan Beg, 1950 m., on the stony mountain side, 24.7.32, *Guest and Ludlow-Hewitt* 3220.

V. carduchorum *Bornm.* (det. Murbeck 1936).

Kurdistan, Hinnis, 450 m., 12.7.33, 3615A; Atrush (N. of Mosul), Kurdistan, 900 m., in crevice on limestone boulder, 13.7.33, 3649 ; Zawita (Gali Qaslik), 840 m., rocky ravine, 27.7.33, 3739.

V. cestroides *Boiss. et Hausskn.* (?) (det. Murbeck, 1936).

Mar Jirjis (nr. Mosul), in a wheat field, native name simra, 22.4.32, *Yussef Lazar* 3352 ; Dohuk, 450 m., in a cornfield on stony land, 21.4.32, 2154.

2154 has not been seen by Murbeck, it appears however to be the same species, although not so densely tomentose.

V. laeto *Boiss. et Hausskn.* et **V. arbelensi** *Bornm.* affine (specimen incompletum) (det. Murbeck 1936).

Zawita Gorge, 840 m., rocky slope, 26.7.33, 3721.

V. laetum *Boiss. et Hausskn.* (det. Murbeck 1936).

Arbil, 375 m., in a cornfield on red loam, 20.4.32, 2132 ; Zawita Gorge, 900 m., on rocky ledges above the gorge, 23.4.32, 2183 ; Mosul, in a wheat field, native name simrah, 9.4.32, *Yussef Lazar* 3353.

" Il me paraît, en effet, assez probable que le *V. laetum* est la même plante que *V. microcarpum* Benth., bien que Bentham caracterise celui-ci par " antheris inferioribus breviter decurrentibus " " (Murbeck).

V. macrocarpum *Boiss.* (det. Murbeck 1936).

Seri Hassan Beg, 1800 m., in a cornfield, 24.7.32, 3028.

V. sinuatum *L.* var. **adenosepalum** *Murb.* in Lunds Univ. Arsskr. N. F. **29,** no. 2, 371 (1933) (det. Murbeck 1936).

Kut, Sept. 29, 204 ; Makatu, nr. Mandali, May 30, 861 ; nr. Zawita, N. of Dohuk (Kurdistan), 900 m., 10.10.31, 1573 ; nr. Mahmudiya (Latifiya Estate), 16.5.32, 2384 ; Bada (N. of Baghdad), on sandy loam in a vegetable garden, native name simrah, 26.5.32, 2504; Mahad (Shaikhan), native name masi jarrak (K.), 24.6.32, *Salim Effendi* 2615; Hinnis, nr. Ain Sifni, 450 m., in a field nr. a stream, 12.7.33, 3615 ; Atrush, 750 m., in a hedgerow by a vineyard, 14.7.33, 3659 ; Zawita Gorge, 840 m., rocky place by the stream, 26.7.33, 3722 ; Zawita, 900 m., gardens on waste land, meat is wrapped and cooked in basal leaves to make " dolma ", native name kavlapir (K.), 27.7.33, 3747 ; nr. Altun Kopri, on Zab River, Bakhtiari conglomerate hills, 8.7.33, 4028.

V. soongaricum *Schrenk* (det. Murbeck 1936).

Arl Gird Dagh, 2100 m., by a stream, 21.7.32, 2825.

Veronica acinifolia *L.*

Jindian, nr. Rowanduz, 25.3.30, 751 ; Shaqlawa, 900–1050 m., on the hill-side, colour pale mauve-blue, 17.4.32, 2015 ; Rowanduz, 750 m., on dry hill-side, 18.4.32, 2050.

V. anagallis-aquatica *L.* (det. P. Davis).

Nr. Zawita, c. 750 m., in a water channel, fls. bright mauve, 22.4.32, 2209.

The literature on Section *Beccabunga* of *Veronica* is to be found under the following:

Rörrupp, H. ; in Fedde Rep. Sp. Nov. Beih. **50,** 1–172 (1928).

Schlenker, G. ; l.c. **90,** 1–40 (1936).

Pennell, F. W. ; The Scrophulariaceae of Eastern Temperate North America 329–376 (1935).

Pennell, F. W. ; The Scrophulariaceae of the Western Himalayas 70–91 (1943).

V. aquatica *Bernh.* (*V. comosa* Richter).

Nr. Kifri, along edge of millstream, Mar. 30, 377 ; Diana nr. Rowanduz, in a millstream, 26.3.30, 716.

There is some doubt as to the valid name of this species.

V. beccabunga *L.* (det. P. Davis).

Chia-i-Mandali (nr. Walza), 250 m., 19.7.32, 2732 ; Arl Gird Dagh, 2700 m., in marshy places by a stream, dark blue fl., 24.7.32, *Guest and Ludlow-Hewitt* 2948.

V. cymbalaria *Bod.*

Rowanduz Gorge, 26.3.30, 603 ; do., in the spray of a waterfall, 750 m., 18.4.32, 2056 ; do., 750 m., 18.4.32, 2116.

V. didyma *Ten.* (*V. polita* Fries. Novit. Fl. Suec. ed. 2, 1 (1828)).

Altun Kopri—Gowair, on top of "Tel", Mar. 30, 381 ; Sumaicha, cultivated field, 2.3.30, 436 ; Rowanduz Gorge, 26.3.30, 602 ; nr. Felluja, on cultivated land, 6.3.30, 980 ; Baghdad, in ditches and damp situations under palm trees at Karada, Mar. 31, 1112.

There has been some doubt as to the correct name of this species. Pennell in "Scrophulariaceae of E. Temperate N. America" (Monog. Acad. Nat. Sci. Philad. **1,** 348 (1935)) gives *V. didyma* Ten. Prod. Fl. Nap. p. VI (1811), as the correct name. He had not seen the original description and assumed that Tenore's description in Syll. Pl. Fl. Neapol. 13 (1831) was the same description. This is not the case. The description in the Prod. Fl. Nap. is shorter, and the differences from *V. agrestis* L. are not given. There appears, however, no reason why the two descriptions should not apply to the same plant. Tenore's specimen in the Kew Herbarium is a good match for a specimen in Fries' collection of *V. polita.* How far Tenore's specimen at Kew can be regarded as the type is open to question, but it should be noted that Fiori (Nuov. Fl. Anal. d'Ital. **2,** 351 (1926)) regards *V. polita* Fries as a synonym of *V. didyma* Ten.

V. hederifolia *L.*

Jindian, nr. Rowanduz, 25.3.30, 743 ; Amadia (Kurdistan), 1050 m., in damp pockets of soil on the mountain side, 26.3.31, 1220.

V. minuta *C.A.M.*

Arl Gird Dagh, 2700–3000 m., in wet places, deep blue, 21.7.32, 2831, 2832 ; do., 3000 m., in wet grassy places by a lake, pale blue fls., 21.7.32, 3071.

V. oxycarpa *Boiss.* approaching *V. anagallis-aquatica* L. (det. P. Davis).

Dohuk, in a stream, native name airum, 26.4.32, *Yussef Lazar* 3341.

V. orientalis *Mill.* (*V. kurdica* Benth. et var. *longeracemosa* Parsa in Kew Bull. 222 (1948), *V. alliaria* Parsa et var. *canescens* Parsa l.c. 220).

Marmarut Mt. (nr. Rowanduz), 900–1200 m., on the stony mountain side, 19.4.32, 2150 ; Arl Gird Dagh, 2700–3000 m., in wet places, pale blue fls., 21.7.32, 2830 ; do., 2700 m., in patches round bushes by a lake, pale blue fls., 2945 ; Zawita, 900–1200 m., 28.7.33, 4666.

The characters said to distinguish the species given in synonymy " break down " when a sufficient range of material is examined. There is great variation in *V. orientalis* in the size of the plant as well as in size of corolla and capsule, length of pedicel, and 4 or 5 lobed calyx. Since there is little correlation shown by these characters, it seems preferable, for the present, to regard *V. orientalis* as one polymorphic species rather than as several species.

V. punctata *Hamilton* (det. P. Davis).

Shaikhan, in wet places, good fodder plant, native name tarshuk (K.), 19.6.32, *Salim Effendi* 2591 ; Rowanduz Gorge, 600 m., under a wet overhanging cliff, 25.7.32, 2978.

These specimens are near *V. lysimachioides* Boiss. and *V. beccabungoides* Bornm. ; they have petiolated leaves and very small capsules.

V. syriaca *Roem. et Sch.*

Amadia, 1050 m., 27.3.31, 1263.

Orobanchaceae

Cistanche tubulosa (*Schenck*) *Wight.*

Tursak nr. Mandali, apparently parasitic on the roots of *Capparis spinosa* (?) on the banks of channels, etc., fls. golden yellow, native name 'air or zib-az-zamal, 26.3.32, 1742 ; Southern desert (between Zubair and Jaliba), on high very sandy soil strewn with small pebbles in *Haloxylon* association, 8.4.33, *Guest, Eig and Zohary* 5065.

Orobanche aegyptiaca *Pers.*

Zawita, 900 m., in a tobacco field, said to be parasitic on tomato, 10.10.31, 1671 ; Baghdad, parasitic on tomatoes, native name lisan-ath-thor, 18.11.32, *Yussef Lazar* 3593 ; do, 900 m., gardens below village, parasitic on tomato, tobacco, potato, etc., 27.7.33, 3741.

O. anatolica *Boiss. et Reut.*

Arl Gird Dagh, 3000 m., apparently parasitic on the roots of Astragalus bushes, 22.7.32, *Guest and Ludlow-Hewitt* 2892 ; do., 2550 m., growing among thistles and *Astragalus* bushes, parasitic on the roots of one or the other (?), 24.7.32, *do.* 2939.

In the key to the forms of *O. anatalica* in Pflanzenr. **4,** 261, p. 277 (1930), these come down to var. *genuina* Beck. f. *gymnostemon* Beck and *f. typica* Beck.

O. crenata *Forsk.*

Chia-i-Mandali (Rowanduz Area), 2400 m., apparently parsitic on the roots of fennel (?), 19.7.32, 2718.

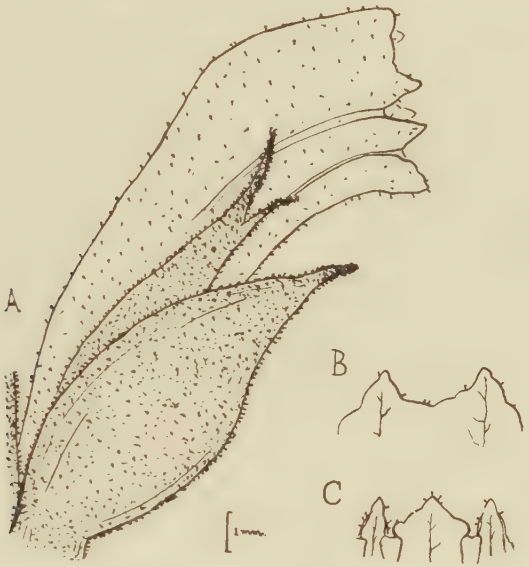

Fig. 5. *Orobanche ovata* Blakelock. A. flower and bract; B. dorsal lip of corolla from the inside; C. ventral lip of corolla from the inside.

Orobanche ovata *Blakelock* sp. nov. ; a omnibus speciebus gregis *Minorum* bracteis ovatis differt (Fig. 5).

Herba 5·5–10 cm. alta. *Caulis* crassus vel crassiusculus glanduloso-pubescens in sicco brunneus roseo- vel rubro-suffusus, 2–10 mm. latus. *Squamae* late triangulari-ovatae, extra glanduloso-pubescens intus minus glanduloso-pubescentes, in sicco laete brunneae roseo- vel rubro-suffusae. *Spica* cylindrica, densiuscula, apice comosa, basi nonnunquam laxiflora, 2·5–5 cm. longa, 2–3·4 cm. lata. *Bracteae* ovatae, concavae, valde acuminatae apice saepe recurvato-patentes, tomento coloreque squamis similes, 10–14 mm. longae, 5–6 mm. latae. *Calycis* partes separatae, oblique lanceolatae, inaequaliter bidentatae, extra glanduloso-pubescentes, 10–11 mm. longae, 2·5–3 mm. latae ; dentes anguste triangulares, divergentes, 1–4 mm. longi. *Corolla* tubulosa, suberecta, aequaliter leviterque curvata, ad limbum versus paulo ampliata, in sicco ochroleuca vel pallide brunnea saepe apicem versus roseo-suffusa, extra glandulosa 10–16 mm. longa, 4–5 mm. lata ; linea dorsalis aequaliter curvata, in medio complanata, in labio superiore deinde arrecta ; labium superius bilobum, lobis porrectis vel subpatentibus latissime triangularibus obsolete crenulatis ; labium inferius lobis (medio majore) late vel latissime triangularibus obsolete crenulatis, valde plicatum. *Stamina* oblique 2–5 mm. supra corollae basim inserta ; filamenta glabrescentia

apicem versus pilosa vel glabrescentia ; antherae ovatae breviter mucronatae, pilosae, 1·5–2 mm. longae, 1·25–1·5 mm. latae. *Ovarium* oblongo-ellipsoideum ; stylus breviter et parce glandulosus ; stigma bilobum, in sicco brunneum. *Capsula* oblongo-ellipsoidea, 5–8 mm. longa, c. 3 mm. lata.

N. 'Iraq. Jabal E.N.E. of Seri Hassan Beg (Rowanduz Area), 1800 m., parasitic, 24.7.32, *E. R. Guest* 2912.

In Beck-Mannagetta's key in Pflanzenr. **4,** 261, pp. 45, 113–4, 168–171 (1930) this species comes down to *O. apiculata* Wallr. (*O. minor* Sutton). *O. ovata* is clearly distinguished by the short stature, wide bracts, and triangular corolla lobes, which give it a very different appearance from any variety or form of *O. apiculata.* Guest's gathering consists of nine stems, the wide bracts are a constant character in all of them. Unfortunately no field notes on the colour were made, and although some of the corollas show a decided pink tinge in the upper half, the colour of the stigma is unknown.

Bignoniaceae

Campsis radicans (*L.*) *Seem.* (det. N. Y. Sandwith).

Baghdad, alien, on a wall, tall climbing shrub with handsome orange fls. at Alwiya Club, 21.9.33, 3468.

Tecomella undulata (*Sm.*) *Seem.* (*Bignonia undulata* Sm.) (det. N. Y. Sandwith).

Rustam Farm, cultivated ornamental shrub, alien, 12.5.33, 3880.

Pedaliaceae

Sesamum indicum *L.*

Rustam, abnormal sprouting from the fls., Sept. 30, 928 ; nr. Zawita (N. of Mosul), 900 m., cultivated crop, 10.10.31, 1656.

928 is very abnormal ; there are numerous lateral shoots with very small leaves on the upper part of inflorescence, and the crolla enlarged and virescent, almost foliaceous.

Acanthaceae

Acanthus dioscoridis *L.*

Chia-i-Mandali, 1350 m., in an orchard, bright magenta fls., 20.7.32, 2765 ; Jabal E.N.E. of Seri Hassan Beg, 1950 m., bright magenta fls., on the stony mountain side, 24.7.32, *Guest and Ludlow-Hewitt* 2908.

Selaginaceae

Globularia sintenisi *Haussk. et Wettst.*

Zawita, 900 m., on limestone rocks, 27.7.32, 3734 ; do., 1035 m., 1.3.33, on steep limestone slope, 4926 ; Zawita, 1065 m., in oak forest, 1.8.33, 4934.

G. trichosantha *F. et M.*

Suwara Tuka Pass, 1200 m., on the hill-side, fl. dark blue, 24.4.32, 2211 ; Atrush, Kurdistan, 885 m., on red marl banks in open pine forest, 13.7.33, 4392.

VERBENACEAE

Lippia nodiflora (*L.*) *Rich.*

Basra, Oct. 29, 307 ; Rustam, on channels, 16.6.31, *Yussef Lazar* 1175 ; Rustam, on a lawn (and generally in wet places), 11.10.32, *do.* 3465 ; Baghdad, on a lawn at Rustam, native name qurt-al-khail, 22.4.33, do. 3913.

Verbena supina *L.*

Mandali, 9.5.30, 901 ; Rustam, 4.5.31, *Yussef Lazar* 1181.

V. officinalis *L.*

Suwara Tuka (Kurdistan), 1200 m., in a spring, 10.10.31, 1578 ; Jabal E.N.E. of Seri Hassan Beg, 1800 m., by a spring, 24.7.32, *Guest and Ludlow-Hewitt* 2910 ; Rowanduz Gorge, 840 m., by a stream, 17.7.32, 2994 ; Seri Hassan Beg, 1500 m., by a stream, 24.7 32, 3044 ; Rustam, 4.6.32, *Yussef Lazar* 3442 ; Atrush, 900 m., by a spring, 13.7.33, 3638.

Vitex agnus-castus *L.* var. **pseudo-negundo** *Hausskn.* ex. Bornm. in Beih. Bot. Centralbl. **22,** abt. 2, 117 (1907).

Mandali, 9.5.30, 800 ; Daima nr. Mandali, in a stony river bed, May 31, 865 ; Rowanduz Gorge (Kurdistan), 600 m., 12.10.31, 1593.

LABIATAE

Ajuga oblongata *MB.*

Nr. Rustam, Aug. 29, 165 ; Aziziya, Sept. 29, 216.

A. orientalis *L.*

Amadia, 1020 m., in cultivated fields in the valley (under trees, etc.), 26.3.31, 1229.

Ajuga vestita *Boiss.*

Zawita Gorge, 900 m., on high rocky ledges above the gorge, 23.4.32, 2201.

Turrill in New Phytolog. **33,** 225 (1934) keeps this species specifically distinct from *A. chia* Schreb.

Ballota nigra *L.*

Jabal E.N.E. of Seri Hassan Beg, 1950 m., by a stream, 24.7.32, 2913.

Calamintha staminea *Boiss.*

Amadia, Kurdistan, c. 1500 m., on rocks in Sulaf Gorge, 2.8.33, 3771.

Calamintha staminea *Boiss.* var. **pilosa** *Post* in Bull. Herb. Boiss. ser. 1, **3,** 162 (1895).

Zawita Gorge, 780 m., rocky slopes, fls. mauve, 26.7.33, 3727; Zawita, 1170 m., among clumps of pines by outcrop of flat limestone terraces, aromatic smell, 28.7.33, 4562, 4563 ; do., 1200 m., on shady limestone cliff, 28.7.33, 4622 ; do., 1065 m., in oak forest, 1.8.33, 4942.

Bornmüller states the type of var. *pilosa* Post is identical with *C. leucotricha* Stapf in Sintenis exsicc. (in Beih. Bot. Centralbl. **22,** abt. II, 120 (1907)). In the Kew Herbarium " Kurdistania : Mardin, 23.7.88,

Sintenis 1352 " under the invalidly published name *C. leucotricha* Stapf is a good match for our material. The amount of indumentum varies considerably.

Calamintha staminea *Boiss.* ad var. **pilosa** *Post* vergens.

Amadia, Kurdistan, c. 1500 m., on rocks in Mazurka Gorge, 2.8.33, 3782.

The calyces are as hairy as in var. *pilosa*, but the indumentum of the leaves and stems resembles that of the typical form.

Clinopodium vulgare *L.* (*Calamintha clinopodium* Benth.).

Arl Gird Dagh (nr. Nawanda), 1500 m., in a hedge row, 20.7.32, 2778.

Eremostachys laciniata (*L.*) *Bunge.*

Between Altun Kopri and Kirkuk, 240 m., in a cornfield, plentifully found in a single locality, 16.4.32, 1984.

Lallemantia iberica *Fisch. et Mey.*

Mosul, 270 m., in cultivated fields on the old rampart of Nineveh, 2.4.31, 1343 ; Royal Estate, Khanaqin, Persian border, native name simsim barri, 1933, 3594 ; Tal Afar, 375 m., in a field on hard but friable soil, 26.4.33, *Guest, Eig and Zohary* 5117.

Lamium amplexicaule *L.*

Rustam, Mar. 30, 367 ; Diana nr. Rowanduz, 26.3.30, 701 ; Baghdad, in grassy places in thickets at Karada, 20.2.31, 1083 ; Amadia, Kurdistan, 900–1200 m., very common in damp shady places under rocks, etc., 26.3.31, 1224 ; Mosul, in a garden 8.4.32, *Yussef Lazar* 3389.

L. aff. **iranico** *Parsa.*

Chia-i-Mandali, 2700 m., on rocky mountain side, pale pink, 19.7.32, 2715.

Our plant differs from *L. iranicum* in the larger more cordate upper leaves and in having wider teeth in some of the calyces. A curious feature of this specimen is the variation in the shape of the calyx teeth, which are very widely triangular or narrowly triangular on the same shoot. In view of this variation more accurate identification has been postponed until more material is available.

L. striatum *S. et S.*

Ser Amadia (Kurdistan), 1800 m., Apr. 31, *Ludlow-Hewitt* 1536 ; Arl Gird Dagh, 1800 m., by a stream, 20.7.32, 2784.

L. tomentosum *Willd.* a floribus albis.

Arl Gird Dagh, 3600 m., among rocks, fls. white, 22.7.32, 2885.

Lycopus europaeus *L.*

Amara marshes, on mud banks, native name barchîbah or tarmahi, 13.12.31, 1626.

Marrubium astranicum *Jacq.* (*M. kotschyi* Boiss. et Hoh.).

Chia-i-Mandali, 2100–2700 m., on stony mountain side among rocks, etc., fl. mauve, 19.7.32, 2723 ; Arl Gird Dagh, 3600 m., on rocks, 22.7.32, 3054.

M. cuneatum *Russ.*

Tuz, 210 m., in cultivated fields, 6.4.31, 1407 ; Qosh Tapa (nr. Arbil), 405 m., in cultivated fields, 2.4.31, 1485 ; Qizil Robat, in a cornfield, 28.3.32, 15.4.32, 1887.

M. crassidens *Boiss.*

Walash (nr. Razinook), 1200 m., on stony hillside, 18.7.32, 2657 ; Zawita Gorge, 840 m., on a rocky slope, 26.7.33, 3716 ; Ser Amadia, 1800 m., on top of the ridge, 3.8.33, 4986.

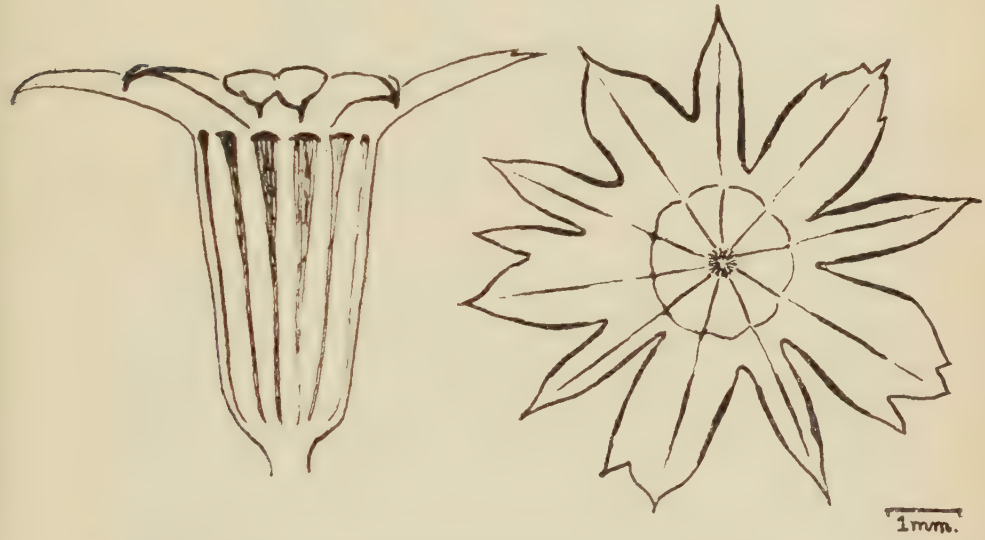

Fig. 6. Calyx of *Marrubium crassidens* Boiss. × *gamodon* Stapf ?

M. crassidens *Boiss.* x **gamodon** *Stapf.*

Nr. Altun Kopri on Zab River, c. 240 m., edge of field below conglomerate hills, 8.7.33, 4032 (Fig. 6).

The vegetative parts, especially the dense tomentum on the leaves, resemble *M. crassidens* as does the size of the calyx, and the abruptly spreading calyx teeth. The shape of the calyx teeth, however, is intermediate between that of *M. gamodon* and *M. crassidens*. A specimen in the Kew Herbarium " 'Iraq : Muwasul Tiatan Mukzuk Nuwar, 26.5.34, *Field and Yussef Lazar* 464 " is intermediate in these characters between *Guest* 4032 and type material of *M. gamodon* Stapf.

Melissa officinalis *L.*

Shaqlawa, 740 m., in a shady orchard, 17.7.32, 3010.

Mentha longifolia (*L.*) *Huds.* var. **incana** (*Willd.*) *Dinsm.*

Rowanduz Gorge (Kurdistan), 600 m., 12.10.31, 456 ; Suwara Tuka (Kurdistan), 1200 m., in a spring, 10.10.31, 1579.

Possibly these are hybrids between *M. longifolia* and *M. aquatica.*

M. longifolia (*L.*) *Huds.* (*M. sylvestris* L.) var. **mollissima** (*Borckh.*) *Fraser* in B.E.C. Rep. 218 (1926).

Seri Hassan Beg, 1800 m., in a ditch, 24.7.32, 3024.

Micromeria juliana (*L.*) *Benth.* var. **myrtifolia** *Boiss.*

Hinnis nr. Ain Sifni (N. of Mosul), 450 m., on a limestone cliff, 12.7.33, 3614 ; Atrush (N. of Mosul), 795 m., on limestone cliff, 12.7.33, 3627 ; Shaikh Adi Gorge, 750 m., on limestone rocks, 14.7.33, 4409 ; Zawita, 740 m., on rocky mountain slope, 26.7.33, 4483, 4491 ; do., 1165 m. in pine forest on limestone crags, 30.7.33, 4765 ; do., on steep limestone slope, 1035 m., 1.8.33, 4928.

M. mollis *Benth.* (*M. flacca* Náběl ek descr.).

Rowanduz Gorge, 600 m., on a rocky cliff (shady situation), 25.7.32, 2972 ; Zawita, 1200 m., on shady limestone cliff, 28.7.33, 4621 ; do., 1050 m., 29.7.33, 4730.

These specimens show intermediates between type material of *M. mollis* and *M. flacca*.

Molucella laevis *L.*

Dohuk, in a peach orchard, native name gazgaz (K.), 26.4.32, *Yussef Lazar* 3346 ; Al Qosh (N. of Mosul), 450 m., in a *Sorghum* field, 15.7.33, 3680.

Nepeta glandulosa *Blakelock* sp. nov. ; §*Longiflorae* Boiss. ; a *N. teucrii-folia* Willd. et *N. iodantha* Náběl ek statu humiliore, indumento glanduloso, foliis latioribus, nuculis majoribus differt (Fig. 7).

Herba perennis, c. 20 cm. alta, radice crassa lignosa multicipite. *Caules* erecti, quadranguli, angulis haud prominentibus breviter glanduloso-pubescentes, sursum violacea suffusi, basi 1–1·5 mm. crassi, distante foliosi internodiis superioribus 1·5–5 cm. longis, foliorum paria 3–4 gerentes. *Folia* late cordata, valde crenata, utrinque dense glanduloso-pubescentia et breviter papillato-strigosa, 0·4–1·4 cm. longa, 0·2–1·6 cm. lata, infima parva, media magna obtuse crenata, superiores majuscula angustiora acute crenata, floralia oblonga vel lanceolata, interdum sub-integra, breviter petiolata, basi cuneata ; petioli 1–10 mm. longi, glandulosi. *Inflorescentia* 1–3-verticillastrata, cymis c. 3-floris, inferioribus pedunculis usque 1·5 cm. longis, superioribus subsessilibus. *Bracteae* lineares, pagina glandulosae, margine glandulosae et setoso-ciliatae, virides usque 6 mm. longae. *Calyx* tubulosus, 15-nervatus, curvatus, intense violaceus, extra glandulosus, intra glanduloso-pubescens (haud piloso-annulatus), 9–11 mm. longus, ore valde obliquus, dentibus inaequalibus triangularibus acuminatis, superioribus 1–2 mm. longis, basi 0·75–1 mm. latis, inferioribus 2–3 mm. longis, basi 0·5–0·75 mm. latis. *Corolla* curvata, parce glanduloso-pubescens, fauce dilatata, 23–30 mm. longa, labio superiore bifido c. 2 mm. longo, labio inferiore orbiculato crenato. *Antherae* et *stigmata* violacea, subexserta vel inclusa. *Nuculae* trigonae, apice et basi obtusae, brunneae, leviter asperulae, minute glandulosae, 3 mm. longae, 1·5 mm. latae.

N. 'Iraq. Arl Gird Dagh, 3300 m., on rocks, 22.7.33, *E. R. Guest* 3067.

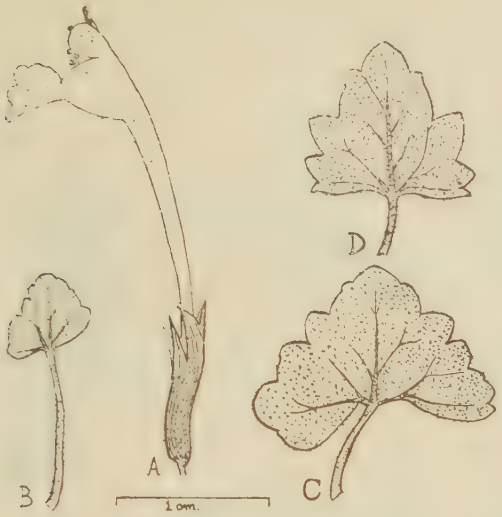

Fig. 7. *Nepeta glandulosa* Blakelock.
A. flower; B. lower leaf; C. middle leaf; D. upper leaf.

The nutlets of " Persia, *Aucher-Eloy* 1751 " (cited by Boissier in Fl. Or. 4, 646, 1879 as *N. teucriifolia* are darker brown with a denser glandular indument, slightly asperulous, 1·5–2 mm. long, 1 mm. wide.

N. haussknechti *Bornm.*

Chia-i-Mandali nr. Walza, 1950 m., in a ditch by a cornfield, 20.7.32, 2740.

N. iodantha *Nábělek* var. **parviflora** *Blakelock* var. nov.; a typo floribus minoribus, calycis 5–6 mm. longis, corollis c. 15 mm. longis differt.

Chia-i-Mandali, 2700 m., on rocky mountain side, fls. purple, 19.7.32, *Guest and Ludlow-Hewitt* 2726 (type of var.); do., fls. reddish, 2727.

N. iodantha I have not seen, but it is described by Nábělek as having calyces c. 8 mm. long and corolla c. 20 mm. long. In its wider, more densely tomentose leaves and in its contracted cymes our plant resembles *N. iodantha* rather than *N. teucrifolia* Willd. or *N. longiflora* Vent.

N. kurdica *Haussk. et Bornm.*

Arl Gird Dagh, 1800–2100 m., on stony mountainside, 24.7.32, 2921; Arl Gird Dagh and on the Jabal E.N.E. of Seri Hassan Beg, 1800–2100 m., on the stony mountainside, purple-blue fls., 24.7.32, 2921A.

N. ludlow-hewittii *Blakelock* sp. nov.; §*Catariae* Boiss.; a *N. crispa* Benth. caulibus simplicibus, foliis majoribus haud crispulis margine obtusius crenatis, floris majoribus distinguitur (Fig. 8).

Herba perennis, cinereo-tomentosa, 20–45 cm. alta, radice crassa lignosa multicipite. *Caules* simplices, erecti vel ascendentes, quadranguli, angulis haud prominentibus, basi glabri sursum tomentosi, basi

Fig. 8. *Nepeta ludlow-hewittii* Blakelock : flower and leaves.

1·5–4 mm. crassi, internodiis usque 8·5 cm. longis, foliosi, foliorum paria 5–7 gerentes. *Folia* ovato-lanceolata, basi subcordata rarius cordata, apicem versus cuneata, obtuse vel acute valde crenata, utrinque tomentosa, 1·5–4·5 cm. longa, 0·9–3 cm. lata, basalia ad squamis brunneas membranaceas 1 cm. usque longas redacta, floralia angustiora subsessilia interdum integra basi cuneata ; petioli usque 1 cm. longi. *Inflorescentia* 1–2-verticillastra, verticillastro superiore e pluribus verticillastris condensatis. *Bracteae* lineares, purpureo-nervatae, tomentosae, usque 6 mm. longae. *Calyx* companulato-tubulosus, rectus, 15-nervatus nervis atro-purpureis, extra tomentosus et parce glandulosus, intra fauce tomentosus et glandulosus, 8–9 mm. longus, ore obliquus, dentibus triangularibus apice angustata, superioribus inaequalibus 1·5–2·5 mm. longis, basi 0·75–1·5 mm. latis, inferioribus 2 mm. longis, basi 1 mm. latis. *Corolla* caeruleo-malvacea, curvata, fauce dilatata, tomentoso-glandulosopubescens, 15–16 mm. longa, labio superiore bifido c. 1·5 mm. longo, labio inferiore orbiculato biconcavo irregulariter crenato medio piloso. *Antherae* et *stigmata* violacea in corollae labio superiore inclusa. *Nuculae* ignotae.

N. 'Iraq. Arl Gird Dagh, 3000–3300 m., among rocks, bluish mauve fls. and fragrant aromatic smell, 22.7.32, *E. R. Guest and E. R. Ludlow-Hewitt* 2871.

N. crispa Benth. has the corolla up to 12 mm. long ; calyx 7 mm. long ; lamina of the leaves generally up to 2 cm. long, 1·5 cm. wide, rarely 3·5 cm. long, 3 cm. wide.

N. trachonitica *Post.*

Zawita range, 1050 m., rocky mountain slope, 25.7.33, 4464.

This specimen shows only the inflorescences in fruit. They are a good match for type material of *N. trachonitica* Post. *N. purpurea* Nábělek from the description and figures in Publ. Fac. Sci. Univ. Masaryk **70,** 55

(1926) is certainly very closely related and possibly not distinct. I have not seen material of Nábělek's species. Unfortunately *N. purpurea* is only known in flower, and *N. trachonitica* in fruit.

N. aff. **longiflorae** *Vent.*

Amadia, Kurdistan, 1500 m., on rocks in Sulaf Gorge, fls. mauve, 2.8.33, 3770.

The nutlets are tuberculate, darker brown and more acute at both ends than those of *Aucher-Eloy* 1749 cited by Boissier (Fl. Or. **4,** 646 (1879)) as *N. longiflora.* Despite the field note on flower colour, the specimen shows no corollas, and has therefore not been described here as new.

[**N. mussinii** *Haenk.*

Persia : Taht-i-Suliman (Mazanderan), c. 3600 m., small plant on stony ground, Apr. 21, *Stark* 1602].

Ocimum basilicum *L.*

Basra, Oct. 29, 295.

Origanum vulgare *L.* var. **viride** *Boiss.* Fl. Or. **4,** 551 (1879).

Chia-i-Mandali (nr. Walza), 1950 m., in a cornfield, 20.7.32, 2744 ; Rowanduz Gorge, 600 m., on a rocky cliff, 25.7.32, 2979 ; Zawita, c. 900 m., on rocky slope, 30.7.33, 4805.

The spikes in some of these are up to 2 cm. long.

Phlomis bruguieri *Desf.*

Arbil, 540 m., on stony red loam in cultivated fields (or fallow), 17.7.32, 2996 ; Atrush Valley, N. of Mosul, 470 m., low-lying pasture land, 12.7.33, 3618 ; do., 570 m., 3619 ; Zawita Valley, 825 m., on red marl banks, 25.7.33, 3686 ; nr. Altun Kopri on Zab River, 270 m., edge of field below conglomerate hills, 8.7.33, 4030 ; Balad Sinjar, 402 m., on roadside grazing strip, 28.4.33, 4121 ; Baba Gurgur, 360 m., 1.5.33, 4382.

4382 does not show flowers but appears to be this species. 3618 has calyx teeth only up to 10 mm. long ; since this is connected to the typical form (calyx teeth up to 20 mm. long) by *Field and Yussef Lazar* 508, 846 (calyx teeth up to 13 mm. long), it has not been given a varietal name.

A revision of this section of *Phlomis* by K. H. Rechinger f. is to be found in Oest. Bot. Zeit. **89,** 257–299 (1940).

P. kurdica *Rechinger f.*

Arbil, 375 m., in a cornfield on stony red loam, 20.4.32, 2134 ; Urfa (nr. Nisibin), by the roadside, 5.6.32, *Sempill* 2544 ; Arbil, 540 m., on stony red loam, 17.7.32, 2997 ; Mosul-Ain Sifni, 360 m., on a stony hillock, 11.7.33, 4037 ; Hinnis nr. Ain Sifni (N. of Mosul), 450 m., in a field, 12.7.33, 4039.

P. praetervisa *Rech. f.* (*P. bruguieri* Desf. x *kurdica* Rech. f.).

Chia-i-Mandali (nr. Walza), 1500–1800 m., very common on the lower slopes of the mountain, 18.7.32, 2662 ; Kirkuk Province, useful grazing plant, native name kūîrkhah, 14.5.33, *Ali Effendi Hadari* 3942 ; Ser Amadia, 1770 m., on a mountain slope, 3.8.33, 4979.

P. rigida *Labill.*

Chia-i-Mandali (nr. Walza), 1650 m., on the stony hill-side, 18.7.32, 2661 ; Arl Gird Dagh, 2400 m., on the stony mountain side, dull magenta fls., 20.7.32, *Guest and Ludlow-Hewitt* 2844 ; Ser Amadia, 1500 m., on open hill-side at the top of Gulli Mazurka, 3.8.33, 4995.

Phlomis sp.

Kani Dolman hills, Kirkuk, 390 m., dry stony rounded hill-top, 30.4.30, 4285.

Material too young.

Prunella vulgaris *L.*

Chia-i-Mandali (nr. Walza), 1950 m., along the edge of a stream, 18.7.32, 2689 ; Arl Gird Dagh, 1800 m., by a stream, purple, 21.7.32, 2848.

Salvia acetabulosa *L.* var. **simplicifolia** *Boiss.*

Dohuk, c. 450 m., common in cultivated fields, 1.4.31, 1320 ; Sulaimaniya—Kirkuk, 300–750 m., 1.4.32, *Ludlow-Hewitt* 1931 ; between Rowanduz and Khanzad Pass, c. 450–600 m., common on low grassy hill-tops, brilliant reddish-purple bracts with pale mauve fls., 16.4.32, 2008 ; Zawita Gorge, 900 m., 23.4.32, 2205 ; Zakho Pass, 900 m.; 750 m., 25.4.32, 2282 ; Diana (nr. Rowanduz), 600 m., 30.4.32, 2354 ; Ain Sifni (Mosul Liwa), fodder plant, native name kul patah (K. , 10.6.32, *Salim Effendi* 2567 ; Dohuk, in the hill valleys, native name rihan kūvi (K.), 2.6.32, *Mekki Beg* 3250 ; Dohuk, on the hill, native name māminah, 26.4.32, *Yussef Lazar* 3349 ; Kirkuk Province, grazing plant, native name kāzbāah, 14.5.33, *Ali Effendi Hadari* 3959.

These specimens show considerable difference in corolla-size and density of indumentum on the inflorescence. Some of them approach closely to *S. szovitsiana* Bunge, which is probably not specifically distinct.

S. aff. **acetabulosae** *L.*

Suwara Tuka Pass, 1200 m., 23.4.32, 2221.

This specimen does not show the fruiting calyces. The upper part of the inflorescence axis and the calyces are more densely pubescent than in most of the specimens listed above.

S. aegyptiaca *L.*

Chuwaiba Wells, nr. Zubair, on sandy soil in a slight depression, 8.4.33, *Guest, Eig and Zohary* 5052.

S. amasiaca *Freyn et Bornm.*

Mahad, nr. Shaikhan, native name kia kurik, good fodder plant, 24.6.32, *Salim Effendi* 2617 ; Jabal E.N.E. of Seri Hassan Beg, 1950 m., on the mountainside, forming beautiful purple clumps with curious sweet smell, 24.7.32, *Guest and Ludlow-Hewitt* 2905 ; Arl Gird Dagh (nr. Rust), 1950 m., at the edge of a cornfield, fls. a beautiful purple-blue, 24.7.32, *Guest and Ludlow-Hewitt* 2929.

2617 is a poor specimen but appears to be *S. amasiaca*. This species and its allies are dealt with by K. H. Rechinger f. in Engl. Bot. Jahrb. **71,** 539–544 (1941).

S. compressa *Vahl.*

Jabal Hamrin nr. Injana, c. 150 m., on sandy soil between rocks, 6.4.31, 1433 ; Jabal Darawishka (nr. Khanaqin), 240 m., on stony hillside, 28 3.32, 1755 ; Naft Khana, 150 m., on stony soil, large erect spreading herb with very pungent smell, 29.3.32, 1853.

S. indica *L.* (*S. brachycalyx* Boiss.).

Amadia (Kurdistan), 900 m., upper petals bright blue, lower rich brown, 25.4.31, *Ludlow-Hewitt* 1501 ; Rowanduz Gorge, c. 600 m., on the mountain side, tall slender plant, fl. deep violet with pale mauve lip, 17.4.32, 2024 ; do., c. 600 m., on the mountain side above the gorge, 30.4.32, *Ludlow-Hewitt* 2024A ; Zakho-Pass, 750 m., on the mountain side, 25.4.32, 2249 ; Marmarut Mts. (nr. Rowanduz), 600–900 m., fls. dark violet with pale mauve lip, 10.5.33, *Cuckney* 3826.

S. lanigera *Poir.* (*S. controversa* Ten. sec. Boiss.).

Ghurfa Plain (nr. Injana), on gypsiferous soil, 12.4.33, *Guest, Eig* and *Zohary* 5080.

S. palaestina *Benth.*

Almost certainly collected near Mosul or Kirkuk, 1929, 144 ; Tuz, 29.3.30, 659 ; Mandali, on channels of cultivated fields, May 30, 872A ; Jabal Darawishka (nr. Khanaqin), 240 m., on stony hillside, 28.3.32, 1799 ; Qizil Robat, at edges of a cornfield, on stony ground, large tufted herb, 30.3.32, 15.4.32, 1886, 1886A ; Tuz, 210 m., in cornfields, fls. bluish mauve, 16.4.32, 2004 ; Sharaban, 30.4.32, *Ludlow-Hewitt* 2363 ; Kirkuk Province, useful grazing plant, leaves are said to contain sugar and to be eaten by the people, native name jūrōkah, 14.5.33, *Ali Effendi Hadari* 3941 ; nr. Ain Sifni (N. of Mosul), 450 m., stony hillside pastures, purple fls., 12.7.33, 4046: Balad Sinjar Tal Afar, 330 m., on roadside strip of waste land, 28.4.33, 4144 ; Ain-al-Husan (nr. Sinjar), 315 m. on open *Poa* steppe, 28.4.33, 4211 ; Kani Dolman hills, Kirkuk, 390 m., on dry stony rounded hill-top, 30.4.33, 4294, 4368 ; Ain Sifni, raised from seed by Herb. Dept. R.B.G. Kew, July–Aug. 34, 5003.

S. palaestina *Benth.* ?

Tuz Khurmatli, c. 210 m., in a cultivated field at Suliman Beg, 6.4.31, 1419.

Material too young for more accurate determination.

S. aff. **sclareae** *L.*

Arl Gird Dagh (nr. Nawanda), 1800 m., in a cornfield, tall erect plant with beautiful pink and white flowering head, 21.7.32, 2852.

The bracts in the upper part of the inflorescence are shorter than the calyces.

S. spinosa *L.*

Kirkuk, on the road to Baba Gurgur oil wells, 300 m., in loose sandy soil, 4.4.31, 1352 ; nr. Kirkuk, c. 300 m., on shale rocks between Baba Gurgur oil wells, 4.4.31, 1353 ; Tuz, 210 m., in cultivated fields, 6.4.31, 1404 ; Jabal Hamrin nr. Injana, 150 m., on sandy soil, 6.4.31, 1434 ;

Qara Tepe, in a cornfield, 16.4.32, 1957 ; Kirkuk, 300 m., in a cornfield, 16.4.32, 1986 ; Daltawa, seed used for eye disease, native name simsim-al-bariah, 26.5.32, 2488 ; Tuz, in a cornfield, 16.4.32, 2316 ; Baqasra (nr. Ain Sifni), on flat "daim" land, fodder plant, native name smaismiyah, 15.6.32, *Salim Effendi* 2590 ; Mosul, in a wheat field, native name hamam, 14.4.32, *Yussef Lazar* 3342 ; Baghdad, in fields at Rustam, native name simsim-al-barriyah, 25.4.33, *do.* 3909 ; Ain Ghazal (Mosul Province), 360 m., in a field, 28.4.33, 4066 ; Baba Gurgur, nr. Kirkuk, 360 m., 1.5.33, 4383.

1434 is more densely hairy than the other specimens. 2590 is rather a poor specimen, but appears to belong to this species.

S. syriaca *L.*

Dohuk, 450 m., in cornfields, 24.4.32, 2162; Zakho-Dohuk, 450 m., common in the cornfields, 24.4.32, 2231 ; Mahad nr. Shaikhan, native name sifaluk (K.), fodder plant, 23.6.32, *Salim Effendi* 2610 ; Arbil Province, native name smaismah, grazed by stock, Apr.–May 31, *Mhd. al Radhi* 3850.

S. trichoclada *Benth.*

Dohuk, 450 m., on the hillside, 22.4.32, 2153 ; Zawita Gorge, 900 m., on high slopes above the gorge, 23.4.32, 2202 ; Shaikh Adi (N. of Mosul), 900 m., on the hill-side in oak forest, 14.7.33, 3670.

S. aff. **trichocladae** *Benth.*

Zakho Pass, 750 m., 24.4.32, 2248.

This plant has the long pedicels of *S. kurdica* Boiss. et Hoh., and the setose indumentum and vegetative parts of *S. trichoclada* Benth.; possibly a hybrid between the two species.

Salvia sp,

Zawita, 1020 m., on red limestone scree soil slope, 29.7.33, 4735 ; do., 1005 m., on rocky bluff, 1.8.33, 4964.

These specimens show neither fls. nor fruit.

Satureia macrantha *C.A.M.*

Rowanduz Gorge (Kurdistan), 750 m., on the rock face in cliffs, 12.10.31, 1551 ; Zawita, N. of Dohuk, Kurdistan, 900 m., 10.10.31, 1565 ; Rowanduz Gorge, 600 m., on rocks, 12.10.31, 1591.

1551 has some of the lower leaves up to 28 mm. long and 7 mm. wide, larger than in other material of *S. macrantha* at Kew.

S. macrantha *C.A.M.* var. **macrosiphonia** (*Bornm.*) stat. nov.

Zawita, N. of Dohuk, Kurdistan, 900 m., 10.10.31, 1565.

1565 shows two shoots with corollas up to c. 12 mm. long, and a third shoot (1565A) with the corolla up to c. 20 mm. In other characters the shoots are identical.

Scutellaria condensata *Rech. f.*

Zawita, 1170 m., in oak forest on steep rocky slope, 28.7.33, 4594.

This matches "Mt. Gara, Kurdistan, 1841, *Kotschy* 389". Unfortunately both specimens are too mature to be run down in K. H. Rechinger's key to *Scutellaria* Sect. *Vulgares* Subsect. *Peregrinae* in Bot. Archiv. **43,** 1–70 (1941). The vegetative parts of *Guest* 4594 seem to agree with those of *Sintenis* 2903, which is cited by Rechinger f. as *S. condensata.*

S. pinnatifida *Arth.*

Arl Girt and Siah Koh (Kurdistan), 3000 m. and over, fine mat of yellow fls., Aug. 31, *Ludlow-Hewitt* 1530; Chia-i-Mandali, 2400–2700 m., 19.7.32, 2714; Arl Gird Dagh, 3300 m., on the rocky mountainside, 21.7.32, 2889.

Sideritis kurdica *Bornm.*

Jabal Robal, S. of Atrush, 750 m., fls. yellow, rocky limestone slope, 14.7.33, 3658; Shaikh Adi (N. of Mosul), 900 m., on the hill-side in oak forest, 14.7.33, 3674A; Zawita Valley, 945 m., among limestone crags, 25.7.33, 4447; Zawita range, 1050 m., on rocky mountain side, 25.7.33, 4456; Zawita, 1200 m., on rocky plateau, 28.7.33, 4582; do., 1210 m., in open oak forest, 30.7.33, 4861.

Stachys ballotaeformis *Vatke.*

Rowanduz Gorge, 600 m., on rocks, 25.7.32, 2974.

There is a revision of this section of *Stachys* by K. H. Rechinger f. in Bot. Jahrb. **71,** 526–546 (1941).

S. burgsdorffioides *Boiss.*

Mahad (nr. Shaikhan), good fodder plant, native name punkah dim hor (K.), 23.6.32, *Salim Effendi* 2611.

S. cretica *L.* subsp. **garana** *(Boiss.) Rech. f.* in Ann. Nat. hist. Mus. Wien **48,** 176 (1937).

Zawita, 900 m., rocky limestone slope, 27.7.33, 3732; do., 1200 m., 28.7.33, 4583.

S. graveolens *Nábělek* e descr.

Dohuk Gorge, 450 m., on a limestone cliff, 25.7.33, 3709.

S. graveolens *Nábělek* f. **congesta** *Nábělek* in Publ. Fac. Sci. Univ. Masar. **70,** 64 (1926) e descr.

Dohuk (Kurdistan), 450 m., 10.10.31, 1587.

S. graveolens *Nábělek* x **fragillima** *Bornm.* ?

Zawita, 1050 m., on rocks, 29.7.33, 4731.

This differs from type material of *S. fragillima* in the oblong lanceolate leaves, in the smaller leaves subtending the verticillasters and in the smaller corollas (10–14 mm. long). The longer and narrower calyx teeth distinguish our plant from *S. graveolens.*

S. kotschyi *Boiss.*

Amadia, Kurdistan, c. 1500 m., on rocks in Sulaf Gorge, 2.8.33, 3772.

The indumentum is somewhat thinner and more appressed than in type material.

S. kurdica *Boiss. et Hoh.*

Walza on Chia-i-Mandali Mt. (Rowanduz Area), 2100 m., on rocks, 18.7.32, 2703 ; Chia-i-Mandali, 1800 m., on the stony hill-side, 20.7.32, 2766.

S. kurdica *Boiss. et Hoh.* var. **glaber** *Blakelock* var. nov.; a typo caulibus foliisque glabris vel subglabris, calycis indumento sparsiore differt.

Amadia, Kurdistan, c. 1500 m., on rocks above Sulaf in Mazurka Gorge, [Aug. 33], *Guest* 3774.

This variety shows some resemblance to *S. benthamiana* Boiss. var. *glaberrima* Bornm. in Beih. Bot. Centralbl. **22,** abt. II. 132 (1907) but differs in the narrower leaves and in the less glandular indumentum on the calyx.

S. lanigera (*Bornm.*) *Rech. f.*

Rowanduz Gorge, 600 m., on a rocky cliff, fls. white ?, 25.7.32, 2973.

S. lavandulaefolia *Vahl.*

Chia-i-Mandali, 2700 m., on top of the ridge among rocks, fragrant smell, pinkish-mauve fls., 19.7.32, *Guest and Ludlow-Hewitt* 2713 ; Arl Gird Dagh, 3300 m., among rocks, plant with fragrant aromatic smell, fls. pinkish-mauve, 22.7.32, 2872.

S. pubescens *Ten.*

Chia-i-Mandali (nr. Walza), 1950 m., in a cornfield, fls. white, 20.7.32, 2739 ; Arl Gird Dagh, 1800 m., by a stream, 21.7.32, 2817.

Teucrium chamaedrys *L.*

Zawita, 1170 m., in oak forest on steep rocky slope, 28.7.33, 4595 ; do., 840 m., mauve fls., 25.7.33, 3693A ; Ser Amadia, 1800 m., on top of the ridge, 3.8.33, 4982.

T. aff. **chamaedryi** L. et **divaricato** *Sieb.*

Zawita, 1200 m., on rocky plateau, 28.7.33, 4573 ; do., 1155 m., in open forest, 30.7.33, 4845.

T. divaricatum *Sieb.*

Zawita, 840 m., mauve fls., 25.7.33, 3693 ; nr. Zawita Gorge, 840 m., rocky mountain slopes, 26.7.33, 3712 ; Badi nr. Dohuk, 825 m., on open hill-side, 25.7.33, 4424 ; Zawita Valley, 825 m., on red marl banks, 25.7.33, 4434 ; Zawita, 1050 m., in pine forest on N. slope, 27.7.33, 4515 ; do., 1125 m., in oak forest on rocky mountain, 28.7.33, 4544 ; do., 1170 m., in clump of pines by an outcrop of flat limestone terraces, 28.7.33, 4557 ; do., 1125 m., on rocky limestone slope, 29.7.33, 4685 ; do., 1140 m., in small pine wood, 29.7.33, 4713 ; do. 1140 m., 29.7.33, 4732 ; Dohuk, 600 m., cultivated in Herbaceous Dept. R.B.G. Kew, 1934, 5010.

These are probably f. *pruinosa* Nábělek e descr. in Publ. Fac. Sci. Univ. Masar. **70,** 72 (1926), a form not dealt with by Rechinger f. in his monograph of *Teucrium* Sect. *Chamaedrys* in Bot. Arch.**42,** 335–420 (1941) nor in Flora Aegaea 494–501 (1943).

T. oliverianum *Gingins.*

Jabal Hamrin (nr. Table Mt.), 150 m., 16.4.32, 1940 ; do., 150 m., on sandstone rocks, fls. bluish-mauve, 15.4.32, 1970 ; do., 30.4.32, *Ludlow-Hewitt* 1970A ; Kirkuk Province, May 33, *Ali Effendi* 3856 ; Southern desert between Zubair and Jaliba', on high very sandy soil strewn with small pebbles in *Haloxylon* association, 8.4.33, *Guest, Eig and Zohary* 5062.

T. parviflorum *Schreb.*

Mahad (nr. Shaikhan), good fodder plant, native name shin shin (K.), 23.6.32, *Salim Effendi* 2608.

T. polium *L.*

Ain Sifni Mosul province , 600–900 m., widely distributed in the hills, good fodder plant for animals and used by man as a specific against fever, native name akhsantin, 8.6.32, *Salim Effendi* 2556 ; Arl Gird Dagh, 1800 m., on a rock, 21.7.32, 2820 ; Zubair (Basra), in sandy desert near 'Iraq–Nejd frontier, fodder plant grazed by sheep and camels, native name ja'ad, 4.5.32, *Abdul Wahab Mustafa* 3156 ; Dohuk, native name gia gūr (K.), 12.5.32, *Mekki Beg* 3283 ; Atrush, 885 m., on red marl slopes in open pine forest, 13.7.33, 3635 ; Kirkuk Province, useful grazing plant, native name kutainah, 13.5.33, *Ali Effendi Hadari* 3929 ; Balad Sinjar–Tal Afar, 330 m., on semi-natural steppe, 28.4.33, 4181 ; Ain-al-Husan, 315 m., on open *Poa* steppe, 28.4.33, 4233 ; Kani Dolman hills, Kirkuk, 390 m., on dry stony rounded hill-top, 30.4.33, 4302 ; Arbil Province, grazed by animals, native name ijadah, Apr. May 1933, *Mdh. al Radhi* 3846 ; Badi nr. Dohuk, 725 m., on open hill-side, 25.7.33, 4417 ; Zawita Gorge, 780 m., on limestone rocks, 26.7.33, 4472 ; Zawita, 1170 m., among clumps of pines by an outcrop of flat limestone terraces, 28.7.33, 4559 ; do., 1200 m., on rocky plateau, 28.7.33, 4574 ; do., 1230 m., in open oak forest, 30.7.33, 4855.

Some of these specimens approach var. *angustifolium.*

T. polium *L.* var. **lanuginosum** *Čelak* in Bot. Centralbl. **14,** 152 (1883).

Nr. Mandali–Koma Sang, 9.5.30, 765 ; Makatu, nr. Mandali, native name alaich-al-ghazal, May 30, 870 ; Arbil, 540 m., on stony red loam in cultivated fields (fallow), 17.7.32, 3001 ; Zawita, 840 m., on rocky mountain slope, 26.7.33, 4492.

T. rigidum *Benth.*

Sulaimaniya, 26.5.30, 813 ; Baba Gurgur nr. Kirkuk, alluvial knole on sandstone bluff, 8.7.33, 4014 ; nr. Altum Kopri on the Zab River, c. 270 m., hills of Bakhtiari conglomerate, 8.7.33, 4025.

[**T. taylori** *Boiss.*

Bahrain [Arabia], Mar. 31, *Ludlow-Hewitt* 1132].

Thymbra sintenisii *Bornm. et Aznavour.*

Badi nr. Dohuk, 825 m., hill-side, low tufted shrub, 25.7.33, 3684 ; Zawita Gorge, 780 m., on limestone rocks, 26.7.33, 4465 ; Zawita, 1125 m., in oak forest on rocky slope, 28.7.33, 4539 ; do., 1110 m., on

rocky slope, 29.7.33, 4673 ; do., 1125 m., on rocky limestone slope, 29.7.33, 4689 ; do., 1155 m., on rocky slope, 29.7.33, 4701 ; do., 1155 m., 30.7.33, 4842 ; do., 1230 m., in open oak forest, 30.7.33, 4858 ; do. 1065 m., in oak forest, 1.8.33, 4935 ; do. 1005 m., on rocky bluff, 1.8.33, 4962.

T. spicata *L.*

Shaqlawa, May 30, *Paterson* 834 ; Ain Sifni (Mosul Liwa), 600 m., on hilly ground, native name za'tar or jata (K.), good fodder plant, 10.6.32, *Salim Effendi* 2569 ; Zawita, 840 m., 25.7.33, 3695 ; Kirkuk Province, useful grazing plant, the dried leaves are used by the people as a condiment for flavouring food, native name hāzūlah, 14.5.33, *Ali Effendi Hadari* 3938 ; nr. Ain Sifni, stony hill-side pastures, 450 m., purplish-red fls., 12.7.33, 4047 ; Atrush, Kurdistan, 785 m., on red marl banks in open pine forest, 13.7.33, 4393 ; Zawita, 840 m., on rocky mountain slope, 26.7.33, 4481 ; do. 1140 m., in small pine wood, 29.7.33, 4709 ; do., 1120 m., in pine forest, 30.7.33, 4830; do., 870 m., on red marl banks, 1.8.33, 4884.

3938 shows no fls. and there is some doubt as to its identification.

Thymus kotschyanus *Boiss. et Heldr.*

Rowanduz Gorge, 750 m., on rocks, 18.4.32, 607 ; Chia-i-Mandali (nr. Walza), 2100 m., among rocks, 18.7.32, 2676 ; do. 2400 m., common on rocks, etc., 20.7.32, 2789 ; Arl Gird Dagh, 3000 m., on rocks, pink fls., 21.7.32, 2828 ; Rowanduz Gorge, 600 m., on a rock cliff, 25.7.32, 2989 ; do., c. 600 m., 10.5.33, *Cuckney* 3828.

2789, 2828 have smaller leaves than in the other specimens, some with the midrib recurved falcate and the lamina bent upwards on each side of the midrib. They match, however, a specimen named by K. Ronniger as *T. kotschyanus* (Persia : Tabriz, *Gilliat-Smith* 1741).

Thymus syriacus *Boiss.*

Arbil Province, native name za'tar, grazed by animals, Apr.–May 33, *Mhd. al Radhi* 3846 ; nr. Altun Kopri on Zab River, c. 270 m., edge of field below conglomerate hills, 8.7.33, 4031.

4031 shows no fls. but appears to be this species.

Ziziphora capitata *L.*

Almost certainly collected near Mosul or Kirkuk, 267B ; Dohuk, 450 m., in a cornfield, 25.4.32, 2294 ; Baqasra (nr. Ain Sifni), 375 n., on hilly ground, native name kia' ai bi zhinah (K.), fodder plant, 15.6.32, *Salim Effendi* 2589 ; Mosul, in a wheatfield, native name zofah, 14.4.32, *Yussef Lazar* 3823.

Z. clinopodiodes *M.B.* var. **canescens** (*Benth.*) *Boiss.* Fl. Or. **4,** 585 (1879).

Chia-i-Mandali (nr. Walza), 210 m., among rocks, 18.7.32, 2679.

Z. clinopodioides *M.B.* var. **dasyantha** (*M.B.*) *Boiss.* Fl. Or. **4,** 586 (1879).

Arl Gird Dagh, 3600 m., on rocks, 21.7.32, 3058.

Z. tenuior *L.*

Mahad (nr. Shaikhan), native name punkah dim shin (K.), 23.6.32, *Salim Effendi* 2609 ; Dohuk, native name punk da'imi (K.), 12.5.32, *Mekki Beg* 3279 ; Jazira Desert, 20.4.33, *Edmonds* 3816 ; Arbil Province, grazed by livestock, native name na'na', May 33, *Mhd. al Rahdi* 3845, 3863 ; Kirkuk Province, useful grazing plant also used to alleviate belly ache in children, 14.5.33, *Ali Effendi Hadari* 3949 ; Ain Ghazal (Mosul Province , 360 m., in a field, 28.4.33, 4074 ; Ain-al-Husan (nr. Sinjar), 315 m., on open *Poa* steppe, 28.4.33, 4202 ; Kani Dolman hills, Kirkuk 390 m., on dry stony rounded hill top, 30.4.33, 4327, 4362 ; Ghurfa Plain, (nr. Injana), on gypsiferous soil, *Guest, Eig and Zohary* 5032.

Gums and Resins*: —This latest addition to the " New Series of Plant Science Books " issued by Chronica Botanica, is written by a member of the Kew Staff and deals with the vegetable gums and resins in general, and the plants producing them, with special emphasis on those gums and resins that are of commercial importance. The book is divided into two parts, the first dealing with gums and the second with resins. This was considered desirable as gums have entirely different properties and uses from resins and interest different classes of users.

In the Gum Section there are chapters on the Nature and Uses of Gums, Gum Arabic and other Acacia Gums, Gum Tragacanth and Similar Gums, Some Well Known or Much Used Asiatic Gums, Gums of the New World and Miscellaneous and Little Known Gums. The Resin section includes chapters on the Properties and Uses of Resins, The Copals, Rosin or Colophony, Dammars, Kauri Resin, Lac Resin and Shellac, Some Little Used Varnish Resins, Elemi, Natural Lacquers, Frankincense and Myrrh, Medicinal and Other Resins. An index of botanical names, and one of common names and authors, is included, also a detailed bibliography.

In spite of the developments in the synthetic field natural gums and resins are still in keen demand and their use in industry does not decline. At one time it was thought synthetic resins would completely replace natural resins for many purposes, particularly in the paint and varnish industries, but this has not materialised. New types of resin, showing much promise, have been developed which are combinations of synthetic and of natural resins, the best examples being the so-called " copal sype synthetics ". The main use for gums may be said to remain the tame as it was centuries ago, as food for man, for most of the gum imported is used in the confectionery trades.

Special attention has been given in the book to those gums and resins that have only become of commercial importance in comparatively recent years, and which are not dealt with in older works of reference. Examples are, carob seed or locust gum, karaya or Sterculia gum and other tragacanth substitutes, also certain Acacias now known to be exploited for gum, particularly in East Africa.

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*Vegetable Gums and Resins by F. N. Howes, D.Sc. Chronica Botanica Coy., Waltham, Mass., U.S.A., 1949, pp. 188, illus. 39, price $5. (London agents : Wm. Dawson Ltd., Cannon House, Macklin Street, W.C.2.).

Plant Nutrition. The experimental investigation of the mineral nutrition of plants has, in recent years, yielded such a wealth of data that those who have no specialized knowledge of this subject are frequently overwhelmed by its complexity. With this background in mind, Professor D. R. Hoagland,* of the University of California, who, with his colleagues, has been actively engaged in research on the inorganic nutrition of plants for a number of years, presented a summary of his conclusions concerning certain aspects of his work in the form of 7 Prather lectures, given at Harvard University. The lectures were first published in the form of a book in 1944, of which a reprint made in 1948 is now under review. Professor Hoagland's clear and lucid presentation has been welcomed, and will doubtless continue to be appreciated, by specialists in inorganic plant nutrition. Workers in other branches of botany who wish to view their own specialized work against a physiological background will also find that the book contains much to interest them, and to stimulate thought.

The author makes no claim that the book is a monograph or textbook of his subject. Nevertheless, he deals with such diverse problems as the relationship between the plant and the soil, the uptake and translocation and of mineral foodstuffs by the plant, the part played by mineral substances in the synthesis of complex biochemical substances such as proteins, the growth of plants in sand and water cultures, and the role of potassium in the metabolism of the plant. Certain aspects of diseases due to deficiences of trace elements or micronutrients are also dealt with, and it is shown that inadequate supplies may have a pronounced influence, not only on the plants themselves, but also on the animals that consume them as food. In other words it is often desirable for the worth of a crop to be assessed on its nutritional value to animals, and not solely on the bulk of its yield. Then again a crop may absorb mineral substances that cause no visible symptoms of disease in the plants themselves, although animals that browse on them are adversely affected. For example, a disease of cattle in Dakota is due to the presence of selenium in the herbage on which they feed, whilst, in certain parts of Britain, molybdenum absorbed from the soil causes pathological symptoms in browsing animals.

The author repeatedly emphasizes the complexity of the inter-relationships of the various physiological processes that he describes. Even when a crop is provided with an apparently adequate supply of mineral substances in the soil, deficiency symptoms may, nevertheless, develop because secondary factors inhibit the uptake of the mineral substances by the plant. One kind of crop plant may be more successful than another in taking up an element from the same soil. Lucerne, for example, was found to absorb zinc far more readily than maize when plants were grown side by side in the same soil in a greenhouse. Or again, symptoms of zinc deficiency may be more pronounced on the sunny than on the shady side of an individual tree.

It is interesting to note how frequently the author stresses the difficulty of explaining the mechanism of the physiological processes he describes

*Hoagland, D. R. Lectures on the inorganic nutrition of Plants. Waltham, Mass. the Chronica Botanica Co.; London W.C.2. Wm. Dawson and Sons Ltd., pp. 226. Second printing 1948. Price $4.50.

in purely chemical and physical terms. He repeatedly refers to the part played by living cells during metabolic processes. This in itself rightly serves to focus attention on our immense ignorance concerning the fundamentals of life. The plant body is a constantly changing system of metabolites. Neither the plant itself, nor the soil in which it grows, remain constant in chemical composition from one moment till the next. When we bear in mind that the form of a plant body is determined by the complex influences of environment and of hereditary stimuli on an elaborate physical and chemical system in which nothing remains static, the range of variation in the form of plants, and the degree of plasticity that they frequently exhibit, need cause no surprise. If the reader is a taxonomist, many of the facts recorded in this book should enable him to gain a clearer picture of the reasons why the classification of living organisms in well defined units is bound to be fraught with difficulty.

The book is fully illustrated with text figures and diagrams, and also includes 28 photographic plates of excellent quality. The book concludes with a general index and an index of authors. A useful, selected bibliography is given at the end of each lecture.

Although the work described is nearly all American, the principles and implications are of such wide significance and importance, that the book can be recommended to all who have to deal with the fundamental problems that underlie the successful production of crops.

C. R. METCALFE.

Plant Physiology. The opening, on June 7th., 1949, of the Earhart Plant Research Laboratory was an event of great botanical interest and importance. Hitherto, plant physiologists who have attempted to grow plants under controlled conditions have been well aware of the many practical difficulties that arise. Growth is influenced by temperature, light intensity and duration, humidity, available food, atmospheric pollution and attack by diseases and pests to mention some of the more important factors. When so many controlling influences have to be taken into consideration, it is most difficult to arrange experiments in which one factor can be varied whilst all the others remain constant. A study of the combined effect of 2 factors is equally or even more complex. In the past, experiments on plant growth have usually been made in small chambers capable of holding only a few plants. In a few instances portions of greenhouses or laboratories have been constructed in which rather more plants have been cultivated in a partially, if not completely, controlled environment. Now, for the first time, the Earhart Laboratory, provides a complete building to be wholly devoted to the growth of plants under precisely controlled conditions. The laboratory, for which the name " phytotron " has been coined, is the gift of Mr. H. Earhart, and forms part of the equipment of the California Institute of Technology. Dr. F. W. Went the designer, is also its first director. This novel laboratory comprises 6 air-conditioned greenhouses

F. W. Went, 1949 : The Earhart Plant Research Laboratory, issued at the occasion of the opening of the new Plant Research Laboratory of the California Institute of Technology, June 7th, 1949., pre-reprinted from Chronica Botanica, Volume 12 (Chronica Botanica Reprint, No. 2, pp. 20, Waltham, Mass., The Chronica Botanica Co.), free.

with natural illumination, and 13 air-conditioned culture rooms lighted with fluorescent lamps. The building also includes 11 darkrooms and 9 general laboratories. The experimental plants, raised and cultivated under sterile conditions, and tended by decontaminated investigators, can be subjected to almost any combination of conditions in which plant life is possible. The temperature, the duration intensity and quality of the light, the purity and movement of the air, humidity, and other variable influences can all be controlled, and the plants, grown in suitable containers on mobile tables or trucks, can be transferred from one environment to another. An exact photographic record of their behaviour can be kept, and they can, in due course be killed and dried, and their remains chemically investigated at the neighbouring Kerckhoff Laboratories. All data concerning the behaviour of the plants is to be entered on International Business Machine Cards, after which " it becomes a simple matter to calculate complex interrelationships between the external factors and the growth responses of the plants ". It has wisely been decided to exclude visitors as far as possible owing to the risk of introducing pathogenic organisms. Further details about the laboratory are not likely to be published for several years.

Meanwhile we must await the outcome of this great venture with interest, and possibly with a feeling of envy for those who will be privileged to work in an establishment with such unrivalled opportunities. Whilst it is to be expected that much new and valuable information will be revealed in the laboratory, it is to be hoped that possible limitations will also be remembered. It is true to say that no 2 individual plants, unless raised by vegetative propagation from the same parent, are exactly alike in hereditary constitution, and it cannot, therefore, be assumed that their reactions to environmental change will be exactly the same. In the face of this variability and tendency towards individualism in plants, which is incapable of complete experimental control, precision of experimental detail might easily exceed that which is justified by the variability of the plants under investigation. Furthermore, however carefully one may control the environment in an experimental chamber, the fact remains that the conditions are very artificial. They may deviate in important, and possibly undetected respects, from those of a natural habitat which one is endeavouring to reproduce. In view of these possible limitations, it appears to the writer that it will be necessary to scrutinize all experimental data with the greatest care to ensure that no misleading conclusions are drawn and no unjustifiable generalizations are made.

C. R. Metcalfe.

Cultivated Crops. New editions have appeared of Bulletin 69 and Bulletin 95 of the Ministry of Agriculture and Fisheries. The former (Third Edition, June 1949, 1/3 net) deals with onions and related crops. The latter (Fourth Edition, June 1949, 2/- net) is concerned with strawberries. Both bulletins have been revised and contain much up-to-date and practical information on the varieties, cultivation, harvesting, pests, and diseases of the crops with which they deal. They are illustrated by clearly reproduced apposite photographs.

W.B.T.

SOME AGARIC DRAWINGS AT KEW, NAMED BY E. M. FRIES.

R. W. G. Dennis.

In a file of miscellaneous drawings, mostly by Berkeley, received at Kew 27 July 1899, are 38 watercolours of Agarics and Boleti in a style strongly reminiscent of Fries' Icones Selectae Hymenomycetum. All have been named in ink in a handwriting recognised by Miss Wakefield as that of E. M. Fries. The majority bear also a more extensive legend, written in pencil in a much finer sloping hand. The species represented are as follows, with Fries labelling quoted first, the pencil legend second. A few drawings also bear brief pencil notes roughly written in Swedish, which I have not attempted to transcribe. The numbers are those on the corners of the originals.

4. "*Agaricus* (*Armillaria*) *bulbiger* A. S. sed icon incorrecta". In pencil : "*Cortinarius leucosporus*=*Armillaria bulbiger* ?" A brief note in Swedish apparently refers to the ring.

1. "*Agaricus* (*Armillaria*) *laqueatus*". No pencil naming but a brief note in Swedish.

6. "*Hygrophorus discoideus* Lindgr." In pencil : "*Hygrophorus discoideus* (Kinnekulle loc. magis denudatis)".

29. "Vix statum idem, sed color umbrinis. Vestrogoth Kinnekulle". Also in ink, but in the same hand as the pencil legends and apparently copied over a pencil legend, as a final " ?" remains in pencil, "*Cortinarius anfractus*, junior". A further brief pencil note is no longer legible with certainty.

55. "*Cortinarius bivelus*, sed absque velo etc." In pencil : "*Cortin. bulbosus*".

54. "*Cortinarius* (*Telamonia*) *brunneus*". In pencil : "*Cortin. brunneus*".

34. "*Cortinarius* (*Telamonia*) *bulbosus* var *tenuis* apparet. Vestrogoth. Kinnekulle". In pencil : "*Cortin. paragaudis*".

— "*Cortinarius* (*Inoloma*) *callisteus*".

45. "*Cortinarius caninus*". In pencil : "*Cortinarius caninus* ?"

46. "*Cortinarii cinnamomei* forma". In pencil : "*Cortinarius* ? ! !".

22. "*Cortinarius claricolor*, junior nec satis speciosus". In pencil : "*Cortinar. claricolor* caelo sicco" and, beneath a drawing with a white pileus, "jove pluvio".

38. "*Cortinarius decoloratus*". In pencil : "*Cortinar. erythropus*".

37. "*Cortinarius decoloratus*". In pencil : "*Cortinar. decoloratus* ? ! !"

5. "*Cortinarius* (*Phlegmac.*) *illibatus* Fr. Ep. Stipes glutinosus" and in apparently the same hand in pencil, "*Cortinarius Phlegmacium illibatus* n. 76 foten med glanz". In the fine pencil hand " ? ! pellicula viscosa".

51. "*Cortinarius impennis*, sed icon non characteristica". In pencil : "*Cortinar. torvus*".

48. "Rite". In ink in a hand like that of the pencil legends, "An "*Cortinarius macropus* ?", to which someone else, perhaps Fries, has added in pencil, "*Telamonia* Fr. n. 131".

35. " *Cortinarius orichalceus* (Batsch) ". In pencil : " *Cortinario fulmineo* affin. ? ! ! "
Rada Ås extra Lidköping (Cortina distincte lutea ! minime alba) species delicatula ".

36. " *Cortinarius* (*Myxac.*) *oricalcheus*. Batsch ". In pencil : " *Cortin. orichalceus* " and word illegible.

50. " *Cortinar.* (*Telamonia*) *paragaudis* ". In pencil : " *Cortinarius rubrosquamosus* ? ". and in another hand " Mycket mörkare hatt" (=cap much darker).

— " *Cortinarius percomis*, sed color justo pallidior ". In pencil : " *Cortin. percomis* Fr. ! ! ! "

44. " *Cortinarius* (*Inoloma*) *pholideus* parvus ". In pencil : " *Cortin. pholideus* " and, added later, " *Inoloma* Fr. 101 ". There are also two brief pencil notes in Swedish.

39. " *Cortinarius* (*Hygrocybe*) *plumbosus* Fr." In pencil : " *Cortinarius spilomeus* ", the specific epithet crossed out in pencil.

33. " Rite ". In pencil : " *Cortinar. purpurascens* " and " *Myxacium n.* 35 " in another hand.

30. " *Cortinarius rapaceus* ". In pencil : " *Cortin. rapaceus* ". A third hand, perhaps Berkeley's has copied " *rapaceus* " in pencil. In the top left corner " *Cortinarius multiformis* " and the number " 2 " are written in the fine pencil hand.

31. No note in ink. In pencil : " *Cortin. rapaceus* e Råda Ås ", with " My n. 26 " in another hand.

27. " *Cortinarius* (*Phlegmacium*) *salor* Epicr. Stipes glutinosus ! " In pencil : " *Cortin. salor* " and in another hand " Fr. n. 79 ".

— " *Cortinarius* (*Myxac. sebaceus* ". In pencil : " An *Cortinarius sebaceus* ? Kinnekulle Blomberg in pinetis—(Pellicula viscosa) ". A later hand has deleted " An " and added " Fr. n. 7 " in pencil.

— " *Cortinarius* (*Myxacium*) *serarius* " and the same beneath in pencil, followed by V. G. Kinnekulle " in ink. In the fine pencil hand : " *C. flavicans* n. sp." There are also two rough pencil notes in Swedish.

— " Rite ". In pencil : " *Cortin. tofaceus* var. *redimitus* Fr." and " n. 95 " in another hand.

23. " *Cortinarius turmalis* ". In pencil : " *Cortin. turmalis* " followed by a note on the adnate cortina, not fully legible.

18. " *Agaricus* (*Flammula*) *fusus* Batsch Vestrogothia Kinnekulle ". In pencil : " *Cortinarius fulvescens* n. sp. Ad truncos vegetos Pini sylvestris. sero autumno (Pellicula viscosa.) Ad Phlegmac. Cliduchios Fr. Epicr."

20. " *Agaricus* (*Hebeloma*) *glutinosus* Lindgr." In pencil : " *Agaricus* ", the rest apparently cut away.

16. " *Agaricus crustuliniformis* Bull. var." In pencil : " *Agaricus* " the rest cut away, so that only the tops of a few letters remain. Also a faint note in Swedish.

13. " *Lactarius obscuratus* (Lasch) Hujus loci. *Ag. Smithii* Klotsch." In pencil : " *Lactarius subumbonatus* n. sp. (Ob. *Lact. umbonatus*) odor fungi sicco exacte Porcorum ".

9. "*Boletus aestivalis* Fries". In pencil : "*Boletus amarus* Persoon ?" followed by a note no longer fully legible but ending "se Bot. Not."

— "*Boletus asprellus* senilis sed icon parva". Pencil note partly cut away.

10. "*Boletus asprellus* junior". In pencil against the pileus "caro pilei pallidior" and below six words in Swedish.

8. "*Boletus impolitus* Fr. Epicris. Vestrogoth. Kinnekulle". In pencil : "*Boletus sapidus* Harzer Essbare Schwamme 1844 . . . . reticulati" and beneath "Harzeri Lindgr." On the back in the fine hand but in ink, "1844 sub nom *Bolet. sapidus* descripsit Harzer Tab. 51".

The fine pencil hand is earlier than the naming by Fries in ink. The latter often partly covers the former, which in a few instances is partly cut away. Presumably the pencil hand is that of the artist and there are several clues to his identity. Of the names described as new species *Lactarius subumbonatus* and *Cortinarius flavicans* are fungi described as new species by J. Lindgren in Botaniska Notiser 1845, where also were published descriptions of *Cortinarius leucosporus*, *Cortinarius tofaceus* redimitus*, *Agaricus glutinous* and *Boletus amarus* Persoon ?, all names found in the fine hand on these figures. Significant, too, is the reference to "Bot. Not" on the drawing of the last named. Among the localities cited by Lindgren are those mentioned on the watercolours, viz. Kinnekulle and Råda Ås extra Lidkoping.

It seems therefore, that the fine pencil hand is that of J. Lindgren, who executed the drawings about 1844–5 and that they subsequently came into the possession of E. M. Fries, who checked the nomenclature and, where necessary, corrected it in accordance with his own opinions.†

Amongst the drawings are apparently sketches of the type collections of :—

Cortinarius flavicans Lindgren 1845=*C. serarius* Fr. 1838.
Cortinarius leucosporus Lindgren 1845=*Armillaria bulbiger* (A. & S. ex Fr.) Quél.
Agaricus (*Hebeloma*) *glutinosus* Lindgren 1845.
Lactarius subumbonatus Lindgren 1845=*Lactarius obnubilis* Lasch 1828.

†This opinion is confirmed by Dr. J. A. Nannfeldt of Uppsala, in a letter received from him after the present manuscript had been sent to press. Three of the plates were sent to Dr. Nannfeldt for his opinion, and he has reported on them as follows :

"Dr. Lundell and I have studied the plates carefully and compared them with the published plates and with the drawings belonging to the Swedish Academy of Science and preserved at 'Naturhistoriska Riksmuseum', Stockholm. We consider it undeniable that the drawings sent by you are Lindgren's original drawings prosecuted during his stay in Västergötland. His notes in Swedish seem to refer to defects in his drawings.

. . . I have found a label written in ink by Lindgren and there can be no doubt that the fine writing in pencil on your drawings is by the same hand . . . . . .

The drawings in Stockholm are evidently made by Fries's artist, Pettersson, from Lindgren's original drawings. And the printed plates were then made from Petersson's drawings. It is evident that Lindgren's drawings are most vivid and expressive. Petersson's have lost a good deal of the characteristic details, and the printed plates have lost still more.

How Lindgren's plates came to England seems still somewhat mysterious to me. It seems evident that they cannot have been sent by Lindgren himself. They must have been sent by Fries. Probably Fries after having them copied considered it unnecessary to keep them and so, sent them as a gift to his friend Berkeley".

Comparison of the drawings with Fries' Icones Selectae Hymenomycetorum reveals the surprising fact that the following are apparently the original sketches from which his published plates were taken :—

Armillaria laqueatus	Icones	Tab.	18	fig. 2	
Armillaria bulbiger	,,	,,	27	,, 2	
Hebeloma glutinosum	,,	,,	112	,, 1	but scales added on pileus
Cortinarius sebaceus	,,	,,	143	,, 1	
C. percomis	,,	,,	143	,, 2	
C. rapaceus	,,	,,	145	,, 1	
C. salor	,,	,,	150	,, 1	
C. callisteus	,,	,,	153	,, 2	
Boletus aestivalis	Sver, Atlas Svamp. Tab. 43				

The plates are taken from drawings, not the latter copied from the plates, because the watercolours show many fine details lost or obscured in the published figures. The published plate of *Cortinarius rapaceus* has clearly been made up by using some of the figures on watercolours 30 and 31 and omitting others. It is interesting to note also that in describing *Cortinarius tofaceus* var *redimitus* Fr. in Monografia Cortinariorum Sueciae p. 52 Fries wrote "*Ic. nostra in Mus. Ac. Holm.* In fagetis Smolandiae semel, copiosus in nemoribus Kinnekulle *Lindgren.*"

It is not clear how these watercolours came to Kew but one may assume they were sent by Fries to Berkeley in the course of their correspondence and hence were presented with the rest of Berkeley's collections.

I am indebted to Dr. Gunnar Degelius of Uppsala for information that the roughly pencilled notes in Swedish are comments on the colouring of the plates and give no help in deciding their authorship. A long inscription in ink on the back of No. 37, *C. decoloratus* is the draft of a speech and bears no reference to the drawing.

Succulent Plants Illustrated*:—The author of this book has devoted much time to the study of succulent plants and its appearance will be welcomed by all those interested in the subject. The present work is intended to serve as an introduction to the study of these fascinating plants. Useful information is presented in a form that should be easily understood by beginners. The book contains 24 full page line drawings, very attractively arranged, depicting one hundred and twenty-six succulent plants representing the main types in cultivation. The accompanying text explains in a clear and concise manner the characteristics and relationships of the plants illustrated. The family Cactaceae is excluded but members of the Crassulaceae, Aizoaceae, Euphorbiaceae, Asclepiadaceae, Liliaceae, Amaryllidaceae, Compositae and Geraniaceae dealt with here have been carefully selected and give some idea of the variety to be found among the large number of succulent plants. The book is printed in a clear and readable type and both author and publisher deserve the thanks of the growing number of devotees of this interesting group of plants.

H. S. MARSHALL.

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* By Vera Higgins. Pp. 71+24 Plates. London : Blandford Press Ltd. 1949. Price 10/6.

A NEW JUNO IRIS.

J. Robert Sealy.

In March 1946 plants of a small Juno Iris grown by Mrs. Gwendolyn Anley, from bulbs collected by Peter Davis the previous year in Transjordan, were sent to Kew for identification and were found to represent a new species. Mr. Davis did not see the species in flower in its native home, and the description below is drawn from the cultivated plants and the fruiting specimens collected by Mr. Davis. Mr. Davis obtained another Juno Iris in Transjordan, namely the species currently known as *I. sindjarensis* Boiss. & Hausskn. Inspection of the synonymy of the latter shows that the oldest epithet for the species has been hitherto neglected, and consequently a new combination is required. This is supplied below.

Iris edomensis Sealy, **species nova** sectionis Juno (Tratt.) Boiss., caule brevissimo, foliis 4–5 rosulatis lineari-lanceolatis in apicem subtiliter acuminatum sensim attenuatis, floribus 1–2, perigonii segmentis exterioribus 3–3·5 cm. longis et 1·5–1·6 cm. latis ungui late cuneato in laminam ovatam rotundatam ecristatam sensim transeunte, anthera splendide caerulea insignis ; ut videtur ex affinitate *I. caeruleae* B. Fedtsch. sed floribus 1–2, perigonii tubo majore, perigonii segmentis interioribus majoribus lamina ovata acuminata latiori, florum colore omnino dissimili differt : habitu *I. persicae* L. simulans sed perigonii segmentis exterioribus exalatis, styli cristis multo angustioribus, foliis ad anthesim longioribus valde discrepat.

Bulbus ovoideus, 3–4·5 cm. longus, 2–3·5 cm. diametro ; tunicae fusco-brunneae, scariosae, numerosae, plantae partem subterraneam 4–6 cm. longam vaginantes. *Caulis* subnullus. *Folia* 4–5, rosulata, patentia et falcata, vel intima ab initio ascendentia, lineari-lanceolata ad apicem subtiliter acuminatum sensim attenuata, 10–15·5 cm. longa, 5–14–(16) mm. lata, valde canaliculata, undulatissima vel in culta leviter undulata, marginibus conspicue albo-incrassatis, supra laete viridia, subtus glauco-viridia, nervis prominentibus (in sicco) ; cataphylla 2, scariosa, obtusa. *Flores* 1–2, sessiles ; spathae oblongae, acuminatae, subaequales, 5–6 cm. longae, 8–10 mm. latae (complanatae), ad anthesim virides et herbaceae demum scariosae. *Perigonium* : tubus gracilis, 5–6·5 cm. longus, pallide viridis supra obscure purpureo suffusus ; *segmenta exteriora* ascendentia lamina decurva, ungui late cuneato in laminam ovatam rotundatam undulatam sensim transeunte, 3–3·5 cm. longa, 1·5–1·6 cm. lata, albescentia maculis longitudinalibus purpureis copiose notata et vitta flava purpureo-maculata in ungui et laminae parte inferiore ornata, ecristata ; *segmenta interiora* ascendentia, 2·2–2·5 cm. longa, parte inferiore lineari-canaliculata et lamina ovata acuminata circiter 4–5 mm. lata, albescentia obscure brunneo-purpureo-maculata. *Stamina* circiter 2 cm. longa ; filamenta gracilia, 12–13 mm. longa ; anthera 8–9 mm. longa, splendide caerulea. *Styli* cristis inclusis circiter 3–3·4 cm. longi, oblongi, 5–8 mm. lati, albovirides ; cristae suboblongae, acuminatae, circiter 1 cm. longae et 2–3 mm. latae purpureo-maculatae. *Capsula* apud folia immersa, spathis persistentibus hyalinis

obtecta, circiter 1·6 cm. longa et 8–9 mm. diametro. *Semina* ellipsoideo-globosa vel subangulata, brunnescentia, testa conspicue rugosa nitidaque, circiter 4 mm. longa et 3 mm. lata.

Transjordan. Edom: E. side of Mt. Hor (above Petra), on sandstone, 18 iv 1945, *P. H. Davis* 8596; above Ein Musa (near Petra), 4000–4500 feet, 19 iv 1945, *P. H. Davis* 8834; pass between Petra and Mt. Hor, on limestone, 27 iv 1945, *P. H. Davis* 9199; near Shobek, 2 iv 1945, *P. H. Davis* 8813. Cult. in horto Anleyensi 12 iii 1946 e bulbo a P. H. Davisio lecto (typus in Herb. Kew.). Growing always in *Artemisia herba-alba* association, fide P. H. Davis.

Iris aucheri (Baker) Sealy, **comb. nov.**

syn. *Xiphion aucheri* Baker in Journ. Bot. **9,** 110 (1871).

Juno aucheri (Baker) Klatt in Bot. Zeit. 1872, p. 498.

Iris sindjarensis Boiss. & Hausskn. in Boissier, Fl. Orient. **5,** 122 (1884); Baker, Handb. Irid. 47 (1892); Dykes, Genus Iris, 196 (1913).

Iris fumosa Boiss. & Hausskn. in Haussknecht, Sched. (1865) ined.] in Boissier, Fl. Orient. **5,** 123 (1884); Baker, Handb. Irid. 47 (1892); Dinsmore, Post Fl. Syria, Palestine and Sinai, ed. 2, **2,** 592 (1933).

S. Anatolia N. Syria N. Irak. Biredjik & Harran, *G. Egger* (sine num.); sine loc. Aleppo? *Aucher-Eloy* 2137 (typus); Djebel Mahassan near Aleppo, *C. Haussknecht* (sine num. anno 1865); Aleppo, *Kotschy* 261; Kalat Simon between Aleppo and Antioch, *F. A. Rogers* 0587; in deserto Wiran scheker, *C. Haussknecht* 904; in deserto fl. Dhliach dhliach, *C. Haussknecht* 905; in deserto Kotuhhassar, *C. Haussknecht* 907.

Transjordan. Edom, between Wadi Musa (near Petra) & Jebel Ashtar, *P. H. Davis* 8839.

Uncinia dikei *Nelmes.*

A CORRECTION.

The new species of *Uncinia* described in Kew Bulletin, 1949, 377–378, was named in honour of its collector, whose name was stated on the label to be Dyke. This name, however, should have been spelt Dike, and the species is therefore to be known as **Uncinia dikei** *Nelmes*, not *U. dykei* Nelmes.

Echinops niveus Wall. var. *burmanicus* Chatterjee. Mount Popa, Myingyan Dist., Burma.

NEW RECORDS OF PLANTS FROM INDIA AND BURMA.*

D. Chatterjee.

Ixonanthes reticulata *Jack* (*Linaceae*).

Burma. Myitkyina District, Pidaung Reserve, 200 m., 30 January 1926 *Maung Mya* 2256.

Previously known from the Malay Peninsula.

Echinops niveus *Wall. ex Royle* var. **burmanicus** *Chatterjee*, var. nov. (*Compositae*). (Plate 2).

Foliis pinnatifidis nec bipinnatifidis vel pinnati-partitis, lamina multo latiore, achaeniis minus pilosis, et stigmatis forma paulo differt.

Burma. Shan Hills, Pwehla, 1230 m., May 1888, *Collett* 655 ; Southern Shan States, Loilem, about 1250 m., *W. A. Robertson* 4 ; Upper Burma, *D. Burke* s.n. ; Meiktila District, Yedwingtaung at the foot of Sabapontaung, 1075 m., 23 October 1936, *H. C. Smith* 13703 ; Myingyan District, Mount Popa, 1000–1300 m., 14 November 1941, *D. Chatterjee* 4117 (type of var.).

Burmese name : *Su-bauk bin.*

Some of the specimens cited above were quoted earlier by Fischer (Kew Bull. **1938**: 295) as belonging to the Western Himalayan species *Echinops niveus* Wall. ex Royle. An examination of the type specimen of this species (*Wall. Cat.* 2986) revealed that the Burmese plants are very different and should be considered at least a variety of *E. niveus*. It appears that the plant is fairly widespread in Burma in the central dry zone. On Mount Popa, where I have been able to observe this plant growing, it was found that it occupies a belt between 1000 and 1300 m. and is seldom found above these limits.

Polygonum forrestii *Diels* (*Polygonaceae*).

Tibet–Assam. Seinghku Wang, 4000 m., 8 June 1926, *Kingdon Ward* 7077 ; Nyima La, 5000 m., 2 July 1924, *Kingdon Ward* 5892 ; Tra La, 4600 m., 1 August 1924, *Kingdon Ward* 6046.

Burma. North-East Burma, *G. Forrest* 26824 ; 27278 ; 24959.

Previously known from Yunnan.

Polygonum campanulatum *Hook. f.* var. **lichiangense** (*W. W. Smith*) *Steward* (*Polygonaceae*).

Burma. Without precise locality, *T. Hay* s.n.

Previously known from Yunnan.

Endospermum chinense *Benth.* var. **genuinum** *Pax et Hoffm.* (*Euphorbiaceae*).

Burma. Myitkyina Dist., Mayan Pidaung Reserve, 300 m., 10 June 1927, *Maung Mya* 5469 (two sheets) ; Toungri-Magoung Reserve, 250 m., 20 May 1927, *Maung Mya* 5440.

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*Continued from Kew Bulletin **1948**, 374 (1949). Unless otherwise stated the sheets referred to in this paper are in Herb. Kew.

Previously known from Hongkong and Hainan.

In his Fl. Br. Ind. **5,** 458 (1887), Hooker considered with some doubt Wallichian sheet no. 7846 from Singapore to belong to this species. The Wallichian sheet, which is only in leaf, resembles more *E. malaccense* Muell-Arg. than *E. chinense* Benth. The main difference being the presence of two basal glands and coarser indumentum on the lamina. Pax and Hoffman (Engl. Pflanzenreich IV, **147,** IV, 36, 1912) have preferred to call the Wallichian sheet a variety of *E. chinense*. Recent collections from the Malay Peninsula have succeeded in obtaining further gatherings of this plant and *Corner's* sheet no. 32255 collected in 1937 from Johore (Sungai Pendas) is undoubtedly conspecific with Wallich's 7846 collected around Singapore in 1822. In my opinion, Wallich's sheet belongs to a distinct species and a specific status is justified as shown below :—

Endospermum malayanum (*Pax et Hoffm.*) *Chatterjee*, stat. nov.

Endospermum chinense Benth. var. *malayanum* Pax et Hoffm. (*l.c.*).

Distribution : Malay Peninsula, Singapore, *Wallich* 7846 ; Perak, *Scortechini* s.n.; Johore, Sungai Pendas, 14 February 1937, *E. J. H. Corner* 32255 ; Selangor, Kuala Lampur, 3 March 1915, *H. N. Ridley* s.n.

Endospermum peltatum *Merrill* (*Euphorbiaceae*).

Andaman Islands. Manglutan, 29 March 1915, *C. E. Parkinson* 461 ; Andamans, without precise locality, *C. E. Parkinson* 1200. Duplicates of these sheets are available in Herb. Dehra Dun.

Previously known from the Philippines.

Neoscortechinia nicobarica (*Hook. f.*) *Pax et Hoffm.* (*Euphorbiaceae*).

Burma. Tavoy, Heinze Chaung Camp, 30 March 1921, *P. T. Russell* 1918.

Previously known from the Andamans.

Sehima nervosum (*Rottl. ex Willd.*) *Stapf* (*Gramineae*).

syn. *Andropogon nervosus* Rottl. ex Willd.
Andropogon striatus Klein ex Willd.
Ischaemum laxum R. Br.
Andropogon philippinensis Merrill.

Assam. Manipur State, Thoubal, 1000 m., 19 December 1942, *N. L. Bor* 16956.

Previously known from Central and East Africa, Western and Southern India, Ceylon, Upper Burma, Yunnan, Siam, Java, the Philippines and Western to Northern Australia.

Hackelochloa porifera (*Hack.*) *Rhind* (*Gramineae*).

Assam. Naga Hills, Yongyimsem, 830 m., 26 September 1942, *N. L. Bor* 356 (in Herb. Dehra Dun).

Previously known from South Burma (Tenasserim) and Indo-China (Tonkin).

Plate 3.

Gelidium helenae Dickinson

[*To face page* 564

Plate 4

Gelidium rumpii Dickinson

To face page 565]

TWO NEW SPECIES OF GELIDIUM FROM NATAL.

C. I. Dickinson.

Gelidium helenae *Dickinson*, sp. nov. Plantae usque 27 cm. altae. Radix fibrosa. Frons compressa, costata, anguste alata, axi primaria 1·5–2 mm. lata tripinnatim ramosa, ramulis determinatis usque 1 cm. longis leviter curvatis acuminatis, pinnis oppositis vel suboppositis. Cystocarpia bilocularia, in apice pinnularum ultimarum per totam plantam edita.

South Africa. Natal, Richard's Bay, July, 1929. *W. G. Rump.* Typus in Herb. Kew.

This species is named in honour of Miss Helena Forbes of the Botanical Station, Durban.

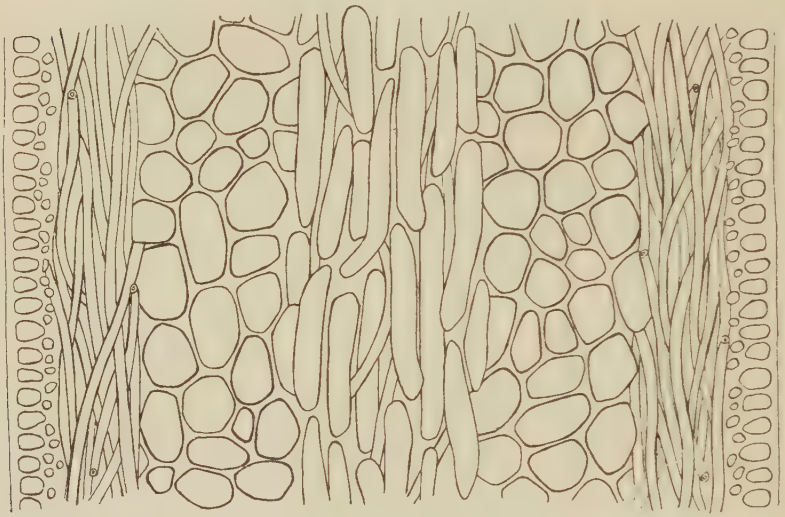
Gelidium rumpii *Dickinson*, sp. nov. Plantae usque 36 cm. altae. Radix fibrosa. Frons compressa, costata, parte superiore late alata, usque 4 mm. lata, costa inferne nuda, ramificatione irregulari distante. Tetrasporangia in apice tumido ramulorum ultimorum sita, irregulariter vel cruciatim divisa. Cystocarpia ignota.

South Africa. Natal, Richard's Bay, July, 1929. *W. G. Rump.* Typus in Herb. Kew.

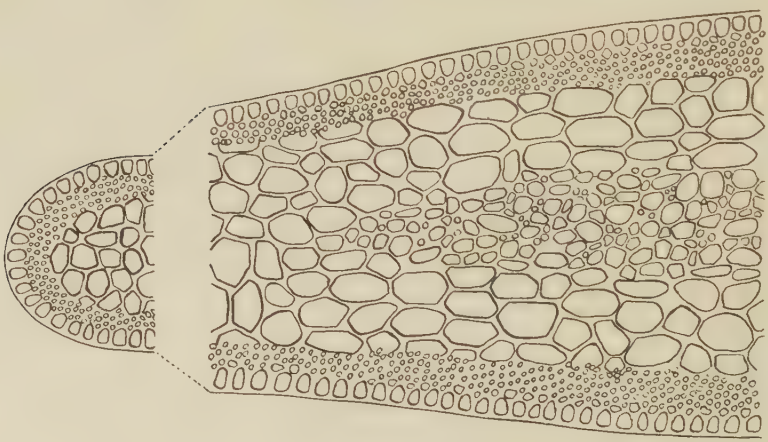
These two handsome plants were in the collection made by Mr. W. G. Rump in Richard's Bay, Natal (see K.B. No. 1, 1949). They were sent without data other than geographical location and time of gathering, but from an examination of the fronds it seems evident that they are perennial ; both show one or two constrictions of the frond from which renewed growth has taken place. They show a similarity in structure. The medulla is composed of long narrow cells interspersed with hyphae. Outside this is a layer of rounded cells, followed by a layer of hyphae, and finally a layer of surface cells slightly elongated transversely.

In trying to place them in the small family of *Gelidiaceae* the problem has arisen of separating *Ptilophora* from *Gelidium*. Kützing proposed the former to accommodate a plant from South Africa which had been described as *Phyllophora spissa*. The important diagnostic characters were the scaly proliferations on the surface of the thallus and more especially the presence of hyaline bristles. Now Papenfuss (3) has thrown some light on the subject by showing conclusively that these hyaline structures are the spicules of an encrusting sponge. Nevertheless without giving a statement of his conception of *Ptilophora* except to say that it is proliferous he transfers to it *Phyllophora diversifolia* Suhr. As stated by Schmitz (4) the proliferating habit seems quite unsatisfactory as a generic distinction, and for this reason he returned *Ptiliphora prolifera* (Harv.) J. Ag. to *Gelidium*. This species has a flattened frond with proliferations on the older parts only. The one other species which has been put into *Ptilophora* is *P. beckeri* Holmes, on the grounds that it has a hyphal layer in the outer cortex. Holmes says " The habit and structure of the plant ally it to *Ptilophora* rather than to *Gelidium* in which I have not seen the infra-cortical fibrous layer characteristic of *Ptilophora* ". We have at Kew a photograph and also a fragment of the type and it has been possible to confirm the presence of this outer hyphal layer. The

cystocarp of Holmes' plant is bilocular and there is apparently nothing in the fruiting character to distinguish it from *Gelidium*. De Toni included in his Sylloge Algarum 33 recognised species of *Gelidium* and of these two are outstanding as having a flat frond with a mid-rib. They are *G. subcostatum* Okam. from Japan, and *G. pinnatifidum* J. Ag. from South Africa. Since then the number of *Gelidium* species has practically doubled but amongst those more recently described only *G. lucasii* (Lucas) May falls into this group with the flat and costate frond.



Gelidium helenae. Fig. 1.
Longitudinal section through the middle of a secondary branch × 230.



Gelidium helenae. Fig. 2.
Transverse section through the middle of a secondary branch × 160.

One fact which emerges from an examination of the flat type under discussion is that they have a common anatomical structure exemplified by *G. helenae* of which figures 1 and 2 represent cross sections. The striking thing about these flattened Gelidiums is that they resemble *Pterocladia* and in fact Lucas described his Australian plant as a variety of *P. lucida*. Dr. Valerie May (2) who has recently made a more thorough investigation, finds that the cystocarps are bilocular and has called the plant *G. lucasii*. One feature which is not brought out in Dr. May's description is the presence in the outer cortex of a distinct though narrow hyphal layer, and in this also it differs from the known species of *Pterocladia*. After an examination of all the flat costate species and a number of terete ones, it seems clear that the former fall into a well defined group made up of *G. subcostatum*, *G. pinnatifidum*, *G. lucasii*, the two species here described and in my opinion to these should be added *Ptilophora beckeri* Holmes. This would leave *Ptilophora* with two species about which too little is known for their proper identification.

References.

1. Holmes, E. M. New Marine Algae. Journ. Bot. **34,** 349 (1896).
2. May, V. Studies on Australian Marine Algae. I. Proc. Linn. Soc. N.S. Wales, **69,** 226 (1944).
3. Papenfuss, G. Notes on South African Marine Algae I. Bot. Notiser, 214 (1940).
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Seventh International Botanical Congress Stockholm 1950.

The Seventh International Botanical Congress will be held in Stockholm between July 12 and 20, 1950. Communication no. 3 from the Organizing Committee containing information on time of final application, membership fee, costs of excursions, expenses in Sweden, visa and money regulations, etc. is now being distributed. It can be obtained from the Secretary General, Dr. Ewert Åberg, Uppsala 7, Sweden.

A NEW SPECIES OF ISCHAEMUM FROM BURMA.

N. L. Bor.

Ischaemum burmanicum *Bor*, sp. nov. ; Species distinctissima ab aliis speciebus spiculis tribus rhacheos basi facile distinguenda.

Gramen annuum. *Culmi* ca. 40 cm. alti, graciles, teretes, laeves glabrique, nodis superioribus ramosi, nodis glabri ; rami omnes inflorescentias gerentes. *Foliorum laminae* 10 cm. longae, 15 mm. latae, inferiores petiolo brevi supra hirsuto praeditae, superiores sessiles vestigiales, basi sagittatae, flaccidulae, setaceo-acuminatae, marginibus scabrae, utrinque pilis parcis e tuberculis ortis adspersae, supra nitentes ; *vaginae* inferiores arctae, laeves glabraeque, striatulae, laminam sagittatam petiolatam gerentes ; superiores arctae, culmum complectentes, laeves glabraeque, laminam rudimentam gerentes ; eae ramorum floriferorum laxae, carinatae, 5 cm. longae, spathiformes, ventricosae, scariosae, laeves glabraeque, racemum complectentes ; *ligula* membranacea, 1–1·5 mm. longa, rubra.

Racemus singulus, pallidus, 4 cm. longus, culmo et ramis terminalis. Nodo inferiore spicula sessilis cum duabus spiculis brevipedicellatis ; internodia rhacheos crassissima, clavata, demum oblique disjungentia, laevia glabraque, nitentia, sessile spicula breviora, 5 mm. longa. Spicularum trium inferiorum *spicula sessilis* 6·5 mm. longa, exaristata ; *gluma inferior* oblongo-lanceolata, 6·5 mm. longa, 1·5 mm. lata, inferne coriacea, marginibus anguste involuta, marginalibus nodulis transverse leviter rugosa, parce vel dense albis pilis ad 3 mm. longis preditae, superne herbacea multis nervis viridibus, apice obtuse acuta ; *gluma superior* explanata lanceolato-acuta, carinata, carina angustissime alata, 3-nervis, chartacea, laevis glabraque, marginibus hyalinis anguste involuta ; apicem versus nervis anastomosantibus viridibus. *Anthoecium inferum* ♂ ; *lemma* 5·5 mm. longum, oblongo-lanceolato–truncatum, hyalinum, enerve ; *palea* similis sed brevior ; *antherae* 3, 3·6 mm. longae. *Anthoecium superius* ♀ ; *lemma* 4·5 mm. longum, lanceolatum, acutum, 1-nerve, hyalinum ; palea similis sed brevior ; *antherae* 3, 3·5 mm. longae ; *stigmata* 2, 2·5 mm. longa ; *styli* duo, 2·5 mm. longi ; *lodiculae* 2, cuneato-truncatae. *Spiculae pedicellatae* ; pedicellus crassus, 0·5 mm. longus, paucis albis pilis praeditus ; *gluma inferior* 6·5 mm. longa, ei spiculae sessilis simillima sed angustior, marginibus paucis nodulis ; *gluma superior* 6 mm. longa, ei spiculae sessilis simillima. *Anthoecium inferum* ♂; *lemma* palea staminaque eis spiculae sessilis similia. *Anthoecium superius* ♀ ; *lemma*, palea, stamina lodiculaeque eis spiculae sessilis simillimae. Alterae spiculae pedicillatae inferioribus omnino similes. Alterae spiculae sessiles inferioribus similes sed ab eis arista calloque distinguendae. *Callus* longior, circiter 2 mm. longus, margine inferiore albis pilis barbatus, dorso albis pilis brevioribus pilosus. *Lemma* lanceolatum, acutum, 4 mm. longum, 1-nerve, ad medium fissum, ex fissura aristam perfectam 1·5 cm. longam emittens ; *columna* brunnea, torta, 7 mm. longa.

Burma. Golden Valley, Rangoon. 23 Dec. 1948, *U Thein Lwin*, 627.

THE USE OF POLYVINYL ALCOHOL AND RELATED COMPOUMDS AS A MOUNTING MEDIUM FOR MICROSCOPE SLIDES.

C. R. Metcalfe and F. R. Richardson.

Some years have now elapsed since Lubin and Carston (1), and subsequently Downs (2), drew attention to the value of polyvinyl alcohol in the preparation of media for embedding, clearing and mounting specimens for histological examination. The substance first aroused interest amongst those concerned with animal tissues. Entomologists subsequently found that it is possible to use the same material for making permanent mounts of insects without having to dehydrate the specimens, as is necessary when using canada balsam. In some cases it has also been used for the examination of living micro-organisms. Owing to the success with which it can be used for zoological purposes, it seemed worthwhile to explore its possible value for mounting small botanical objects and sections of larger specimens. Considerable difficulty was at first experienced in obtaining a supply of polyvinyl alcohol from British sources, but eventually, through the kind co-operation of the manufacturers, Messrs. Shawinigan Ltd., Marlow House, Lloyds Avenue, London E.C.3), two qualities of the proprietary substance " Solvar " were made available. Authority has been given by the manufacturers for it to be stated that " Solvar " is the trade name for partially hydrolysed polyvinyl acetate, and that the substance consists partly of polyvinyl acetate and partly of polyvinyl alcohol. The two grades with which experiments were made are S.57 containing 0–6 per cent., and S.357 with 30–37 per cent., of polyvinyl acetate. S.57 was found to be unsatisfactory because it tends to form a gel, whilst solutions of it are greenish yellow in colour. After some preliminary trials S.57 was discarded in favour of S.357.

In using S.357, which is a coarse, yellowish-white, granular substance a 20 per cent. aqueous stock solution (Solution A) is first prepared. This is done by placing 20 gms. of S.357 in a beaker containing 100 ml. of distilled water and allowing it to soak for a night. The mixture is then heated to 60–70° C. on a water bath, and stirred frequently until the "Solvar" dissolves completely. The solution is allowed to cool, and, after filtering through glass wool, is ready for use.

Two alternative mounting media can be prepared from the stock solution. The first (Solution B) is made by mixing 75 parts of the stock solution with 25 parts of water. It is desirable to add a few drops of a solution of formaldehyde, or a few crystals of thymol, to prevent the development of fungi.

The second mounting medium (Solution C) is made by mixing 50 parts of the stock solution of S.357 with 25 parts of lactic acid and 25 parts of a 6 per cent. aqueous solution of phenol. Solution C clears opaque objects or sections more effectively than does solution B.

When making microscopic slides, objects may be mounted directly in either of these media without preliminary dehydration ; a procedure that is much more rapid than using canada balsam, whilst the risk of distorting the tissues, by dehydrating them too quickly, is reduced. Great care is necessary, however, to ensure that no air bubbles are

trapped under the coverslip. At normal room temperature the mountant will begin to harden around the edges of the coverslip in 1–2 hours, and the hardening process gradually extends inwards. Most slides kept for 18 months are still in as perfect a condition as they were when freshly made, and there is every reason to suppose that the preparations may be regarded as permanent. A further lapse of time will, however, be necessary before this can be fully confirmed. It should be mentioned, however, that in a few preparations in which objects were mounted in solution C, long needle-shaped crystals, believed to be those of phenol, have appeared in the mounting medium after a lapse of time. The crystals were first noted in preparations over a year old. They did not seriously impare the quality of the preparations, because they were very transparent and were deposited in such a way that they radiated from the edges of the specimens or sections, and did not lie above or below them. The refractive index of the mounting medium appears to be quite satisfactory for a wide range of objects, whilst various types of pitting, the outlines of cells, stomata, and other important features form well defined, crisp images, in sections required for histological examination. A notable drawback is that many of the common stains, such as safranin and haematoxylin, cannot be used with S.357 because the dyes tend to diffuse from the sections into the mounting medium. A notable and important exception is cotton blue, which can be added to solution C, and used to make permanent mounts of fungal hyphae. This discovery should be of considerable value to plant pathologists. S.357 is, therefore, most generally useful for mounting objects that do not need to be stained, and there are many items that come into this category.

At the Jodrell Laboratory, solutions B and C have been found to give satisfactory results with the following types of material.

(i)) Surface preparations of the leaf epidermis of various dicotyledonous plants, and, amongst the monocotyledons, of grasses and species of *Agave*, *Iris* and *Orchis*.

(ii) Transverse sections of the lamina of grasses.

(iii) Transverse sections of stems of *Bauhinia* showing anomalous secondary thickening.

(iv) Sections of the secondary xylem of coniferous woods and hardwoods.

(v) Sections of roots, such as those of *Populus* and *Colchicum*.

(vi) Sections of palm stems.

Solution C. has been tried for various purposes by members of the herbarium staff, who have kindly supplied the following notes.

(i) Satisfactory in every way for fern spores, sporangia and scales.
(ii) Excellent for mosses.

(iii) Opinions concerning its value for fungi appear to differ.

In some cases it has not proved to be entirely satisfactory because it causes shrinkage and induces changes of colour. On the other hand, good results have been obtained with inoperculate Discomycetes and Pyrenomycetes, with firm-textured resupinate fungi, hymenomycetes, parasitic fungi, and dermatiaceous moulds.

(iv) No very satisfactory results have been obtained with algae, presumably on account of their delicate nature.

The results so far obtained thus demonstrate that S.357 is a most promising mounting medium for a wide range of botanical material. With delicate or thin-walled tissues it is less satisfactory, because it causes more shrinkage than is desirable. It seems quite probable that S.357 and allied substances may well come to be generally familiar in the preparations of mounting media for botanical purposes.

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TWO NEW GRASSES FROM INDIA.

N. L. Bor.

Oropetium villosulum *Stapf* mss. sp. nov. ; *O. thomaeo* Trin. comparandum, sed ab eo lemmatibus hirsutis, spicis brevioribus, spiculis minoribus, culmis scabris distinguendum.

Gramen annuum, nanum, multicaule, caespitosum. *Culmi* erecti, 1–5 cm. alti, teretes, purpurascentes, infra nodos vel prorsus scabridi, nodis glabri. *Foliorum laminae* rigidae, speciminibus nanis plicatae, robustioribus involutae, lineares, usque 3 cm. longae, acutae, utrinque praecipue supra villosae ; *vaginae* sufflatae, striatae, glabrae, marginibus hyalinae ; *ligulae* brevissimae.

Spica simplex, terminalis, gracilis, 1·5 cm. longa. *Spiculae* solitariae, sessiles, 1-florae, in excavationibus rhacheos distiche immersae. *Gluma inferior* minuta, 0·5–1 mm. longa vel nulla, hyalina, a latere visa hemispherica, enervis ; *gluma superior* rigida, a dorso visa oblongo-obtusa, 2 mm. longa, coriacea, 3-nervis, explanata elliptica, marginibus latis hyalinis. *Lemma* 1·5 mm. longum, explanatum fere 1·5 mm. latum, elliptico-truncatum, 3-nerve, dorso villosum ; *palea* aequilonga, 0·5–0·75 mm. lata, bicarinata, 2-nervis, dorso villosa ; *stamina* 3 ; *antherae* 0·33 mm. longae ; *styli* 2 ; *stigmata* plumosa ; *lodiculae* 2, minutissimae. *Spicula terminalis* 3·5–4 mm. longa ; *glumae* aequilongae, coriaceae, lanceolatae, acuminatae, apicibus recurvatis.

India. Central Provinces : " Rocky bed of stream below Humra, Nimar District ", 21st Dec. 1888, *J. F. Duthie* 8523 (Typus in Herb. Kew.) ; Bombay: " In humidis araneosis circa urbem Poona ", Aug. 1832, *V. Jacquemont* ; Orissa : Sonabera, Oct. 1949, *H. F. Mooney.*

Recently Dr. H. F. Mooney sent to Kew, for naming, a dwarf grass, which he had collected growing in sand pockets on a large outcrop of quartzite near the village of Sonabera in Orissa. Obviously an *Oropetium*, this specimen could not be matched satisfactorily with the existing Indian species, *O. thomaeum* Trin. It was then discovered that the late Dr. Otto Stapf had separated as a distinct species the grass described above but had never published a description. Dr. Mooney's specimen, though depauperate, could be matched with this species and advantage has been taken of this opportunity to describe this grass.

Ischaemum flumineum *Bor*, sp. nov. ; *I. timorensi* Kunth simile sed ab eo gluma spiculae sessilis inferiore bicuspidata aristataque, habitu perenne differt.

Gramen perenne ex radice lignoso duro multis radiculis fibrosis in saxorum rimis incolum. Culmi multi, lignosi, ramosi, basi geniculati deinde erecti, glabri laevesque, graciles, nodis albo-barbati. *Foliorum laminae* anguste elliptico-acuminatae, apicem versus basin versusque attenuatae, ad 10 cm. longae, 5 mm. latae, omnino glabrae vel sparse pilis albis ex tuberculis ortis tectae, utrimque scabrae vel laeves, marginibus involutis scabrae ; vaginae inferiores laxiusculae, eae inflorescentiam terminalem infra teretiusculae, arctae, sine laminam, scariosae, laeves glabraeque vel supra pilis mollibus albis praeditae, nodis albo-pilosae ; *ligula* lacerata, scabra, 1·5–2 mm. longa.

Racemi bini, 4–5 cm. longi, terminales pedunculo longe-exserto, laterales in spatha scariosa sessiles ; spiculae ad quemvis rhacheos nodum binae, una pedicellata a pedicello demum soluta, altera sessilis d mum cum rhacheos internodo accumbente disjungens ; internodia 3 mm. longa, gracilia, sectione triangula, angulis duobus exterioribus ciliata. *Spicula sessilis* lanceolata vel anguste elliptica, 5 mm. longa (cum callo 1 mm. longo) ; *gluma inferior* 4 mm. longa, explanata late ovata, bicarinata, marginibus ciliata, apice bimucronata, in inferiore dimidia parte coriacea in superiore parte chartacea, nervis viridibus prominentibus notata, crista pilorum supra rugam inter glumam et callum praedita ; *gluma superior* (cum callo 1 mm. longo) 5 mm. longa, infra dorso rotundata, carinata exalata superne, 3-nervis, laevis, glabra, paucis pilis longis dorso medio praedita, aristata ; arista 2–3 mm. longa. *Anthoecium inferum* ♂ ; lemma 4 mm. longum, elliptico-acuminatum, 5-nerve, hyalinum ; *palea* aequilonga, hyalina, 2-nervis ; *antherae* 3, 1–1·25 mm. longae. *Anthoecium superius* ♀ ; lemma 2–2·5 mm. longum, oblongum, bilobatum, dorso rotundatum, ad medium fissum, 3-nerve ; arista ex sinu 1·3 cm. longa, geniculata, torta ; palea lemmati aequilonga vel squama hyalina. *Spicula pedicellata* ; pedicellus internodo similis, sed tandum 2·5 mm. longus ; spicula 5 mm. longa, a latere valde compressa ; *gluma inferior* (cum callo 0·75 mm. longo) 3 mm. longa, carinata, lanceolata, 5-nervis, laevis glabraque, dorso paucis pilis longis praedita, brevissime aristata (1·5 mm. longa) ; *gluma superior* navicularis, 4·5 mm. longa, inferne rotundata, superne carinata, dorso pilis albis longis sparse tecta, basi dense barbata, aristata ; *arista* 2·5 mm. longa. *Anthoecium inferum* ♂ ; *lemma* 3·5 mm. longum, lanceolatum, subaristatum, hyalinum, laeve glabrumque ; *palea* aequilonga, 2-nervis ; *antherae* 3, 1·0 mm. longae. *Anthoecium superius* ♂ ; *lemma* 2·5 mm. longum, late oblongum, bilobatum, ex sinu aristata ; *arista* 10 mm. longa, geniculata ; columna 5 mm. longa, torta ; *antherae* 3, 1·5 mm. longae.

India. Bombay : Jog, 28 April 1939, *N. L. Bor* 11390 (Typus in Herb. Kew. et in Herb. Dehra Dun.) ; Madras : Coimbatore, Top Slip, Nov. 1937, *N. L. Bor* s.n.

A perennial with very strong wiry roots growing in the crevices of rock, usually in the bed of a stream.

THE CHINESE TALLOW TREE (SAPIUM SEBIFERUM ROXB.) —A SOURCE OF DRYING OIL.

F. N. Howes.

The shortage and high price of linseed oil in recent years has attracted attention to other vegetable drying oils that may be used in the paint and allied industries. Among such oils is that which has come to be known as "Stillingia oil," supplies of which have been obtained entirely from China. The oil is derived from the kernel of the seed of the Chinese tallow tree (*Sapium sebiferum* Roxb. syn. *Stillingia sebifera* Michx.), and is quite distinct from the so-called Chinese vegetable tallow, a fatty or "waxy" substance derived from the fatty outer covering of the seed, used in China and Japan for candles and imported to the United Kingdom and other western countries.

Linseed oil has long been the basis by which other drying oils used for paints and varnish have been judged. The main sources of supply of linseed are the Argentine, United States and Canada, all hard currency areas. Before the war India was an important producer for oversea markets but exports have been drastically reduced in recent years. In 1947 and early 1948 the Argentine virtually exercised a monopoly as an exporter of linseed and linseed oil and the price to users in the United Kingdom reached the record figure of £200 per ton. Before the war the price was about £25 per ton! At the present time, however, there is said to be no longer a world shortage of linseed, due to greatly increased production in the United States, Canada and the Argentine. Currency restrictions, however, severely limit purchases by many countries. This surplus may only be temporary if reduced areas of linseed are grown in the countries mentioned as seems probable. However, it is considered that there is likely to be a good market for all the linseed grown in the sterling area for many years to come (2). The same may apply to other of the more useful drying oils.

With the restricted supplies of linseed oil and tung oil available to users in the United Kingdom there has been increased interest in Stillingia oil. Prices have been as high as £240 per ton. It would seem that supplies available from China are not large, the total annual output having been estimated to be only about 4,000–5,000 tons. Irregularities of supplies, due to internal unrest in China and transport difficulties may have accounted for the small extent to which the oil has been used in the past in Western countries. The same irregularity of supply from China has been experienced with tung oil in the past, and has been largely responsible for the determined efforts that have been, and are being, made to produce tung oil in other parts of the world.

Sapium sebiferum is widely distributed throughout the southern half of China and has also been cultivated, mainly as an ornamental tree, in many other parts of the world. In China it occurs—at various elevations—in the provinces of Kwang-si, Kwang-tung, Kwei-chow, Hu-nan, Kiang-si, Che-kiang, Sze-chwan, Hu-peh, An-hwei and Hainan. At one time inhabitants in some districts near Hangkow were said to defray all their taxes with the produce of the tree, the tree being reputed to be extremely prevalent in the sandy estuary of Hangkow (7). The tree

may be known by various names in China, the common Cantonese name being " u-kau-shu " or " wu-yau-shoe ". The botanical synonymy is as follows—*Stillingia sebifera* Michx., *Croton sebiferus* L., *Triadica sinensis* Lour., *Excoecaria sebifera* Muell. Arg., *Stillingia sinensis* Muell. Arg., *Carumbium sebiferum* Kurz.

The tree does not normally attain large dimensions being small to medium in size, 15 to 20 feet high, and seldom exceeding 30 feet in height. It may assume the habit of a shrub. In harvesting the fruits the ends of the branches may be lopped off by the Chinese, which has the effect of a severe pruning. The tree is deciduous, the leaves turning a beautiful orange to scarlet colour before falling. The leaves are reminiscent of those of the aspen at first sight, being rhomboid, sharply acuminate and 1–3 inches long and broad. The petioles are slender, from 2–3 inches long with two prominent glands at the base. The attractive autumn colouring of the tree greatly enhances its ornamental value and probably accounts largely for its now wide distribution in other countries as an ornamental tree. In the natural state the tree often has a gnarled trunk. The bark is grey with vertical cracks.

In addition to growing easily from seed the tree readily forms root suckers. The monoecious greenish yellow flowers appear in small, reddish, terminal inflorescences in the Spring ; the male at the top and the female at the base of the inflorescence, which may be from 2–5 inches long. The flowers are said to be fragrant and freely visited by bees (10). The fruit, which ripens in the autumn or at the end of the growing season is a sub-globose, three valved capsule and contains the three wax-coated seeds, 8–10 mm. long when dry or about the size of a small pea. They have an acrid penetrating taste. The capsule dehisces into 2–5 somewhat woody, brittle valves. The waxy or fatty layer of the seed is immediately under the epidermis and gives to the seed its striking and pure white appearance. The kernel itself, of a pale straw colour, is surrounded by a hard, brittle, brown shell. The average weight of a seed may be rather more than 0.15 gm. (1).

In addition to China and Japan, where the tree has long been grown, the tree also occurs or is cultivated in Indo-China, but it would appear that it is not exploited there for the " tallow " surrounding the seed nor for the kernel oil. The leaves, however, may be employed there as a black dye for silk, and this would seem to be the only economic use of the tree in that region (4). In China one observer (McClure) states that the roots may be used medicinally as a purgative. The wood of the tree is not considered to be of much value. The tree is long lived and it is said that in China " trees are known to be several hundred years old and though prostrated, still send forth branches and bear fruit " (7).

In India, particularly northern India, the tree has long been established and has become quite naturalized in some areas where it may be very prevalent. It is stated that the tree " is largely cultivated in northern India occasionally up to 6,000 feet in the Himalaya ; but sometimes in other localities, including Burma. In the Changa Manga plantation near Lahore it does well only near water. In northern India it has run wild and has spread extensively, not only from seed but also by means of root-suckers, which it produces in great abundance, and

as it is not browsed by cattle it is able to survive in grazed areas. It coppices well. The tree is frost-hardy, and stands a certain amount of shade. In order to run wild it seems to require a fairly heavy rainfall or else a moist soil. It has established itself thoroughly around Dehra Dun, particularly on gravelly soil in ravine lands, in the moister parts of the Kangra valley and on islands in the Jhelum river on the plains. It is a useful tree for fixing sides of ravines and banks of rivers " (10). Near Dehra Dun the tree is often defoliated by the larvae of the moth *Ophiusa melicerte* (5).

An interesting point about *Sapium sebiferum* in India is the facility with which it appears to hybridize with one of the indigenous species of *Sapium*, i.e. *S. eugeniaefolium* Ham. The following observations by R. N. Parker, recorded on one of his herbarium specimens (No. 2119. Thal, Almora District 1923) may be of interest. " *Sapium eugeniaefolium* Ham. is indigenous in the Ramganga valley near Thal. *S. sebiferum* Roxb. is planted and naturalized. Old trees are easily distinguished as the former has much smoother bark than the latter. In the case of smaller specimens it is difficult to say which is which. In fact, I think almost all the young stock is either *S. sebiferum* or the hybrid *S. eugeniifolium* x *sebiferum*. The latter being a more vigorous tree it looks as if the pure *S. eugeniifolium* will die out in this area ".

Sapium sebiferum is reputed to be naturalized in the vicinity of Batavia in Java (6) yet Burkill (3) states that several attempts to establish the tree at the Singapore Botanic Garden failed. The tree has been cultivated in Southern Europe, including La Mortala, Italy, and Perpignan in the South of France, the Soudan, Martinique, the southern United States and various other countries. Old records at Kew show that Wardian cases with young plants were sent from Kew to the " Resident Councillor " of Penang in 1866 and to Mexico in 1867 and Jamaica in 1869. There appears to be no record of how these early introductions from Kew fared. Parts of Mexico and Jamaica would probably have afforded conditions suited to the tree. Young plants or seeds were also sent from Kew to India in 1863–4, but it would seem that the tree had been introduced before that time (7).

The date of introduction of *Sapium sebiferum* to the United States has been given as 1850 (8), but it appears that the tree had been grown there before that time. In the Kew Herbarium there is a specimen (in flower) collected in 1832 by Drummond from New Orleans, the specimen belonging to the original Bentham herbarium. Two other old specimens in the same collection consists of one from Louisiana (in fruit) collected before 1854 and another from Perpignan, France, collected in 1829. There are also old specimens in the Kew Herbarium from Cuba (1865), St. Vincent and Brazil (before 1867).

In the United States *Sapium sebiferum* may not have been cultivated to any extent until the early part of the present century. It now thrives in the Gulf Coast areas where it is cultivated as a shade or a street tree. Recently it has been investigated there as a possible source of oil for paint manufacture in the United States . The oil was found satisfactory but it was considered that exploitation was not likely to be profitable, mainly on account of the difficulty of economically harvesting the seeds in the

United States (Public Ledger, Oct. 15. 1947). The tree has been described in the United States as " a large tree reaching a height of 15 metres " (9). From this statement it would seem that possibly the tree attains larger average dimensions under cultivation there than it does in its natural habitat in China.

Under favourable conditions the tree makes rapid growth. The average height of young trees of different ages in Indo-China is given as follows (4).

1	year	old	tree	1·20	metres	high
2	,,	,,	,,	2·30–2·40	,,	,,
3	,,	,,	,,	3·20–3·30	,,	,,
4	,,	,,	,,	4·50	,,	,,

The average trunk circumference of the trees at 4 years of age, when bearing commenced, was 30–35 cm. From these figures the rate of growth during the early life of the tree would appear to be approximately a metre a year (4).

In addition to a fairly rapid rate of growth the tree comes into bearing at an early age and may commence to produce flowers and seeds after about the fourth year. One writer (4) estimates the production of 7–8 year old trees (in Indo-China) as 8–12 kmg. of seed per annum. A spacing of 5 metres between the trees is recommended, the seeds being sown *in situ*, three or four seeds to each hole.

In China harvesting takes place in the autumn (Sept. to Nov.) the ripe or ripening fruits being plucked from the trees, or else the branches first cut to facilitate removal of the bunches. Harvesting is only carried out seriously in areas where the trees are abundant. The ripe condition of the fruit bunches is easily detected as they turn a brownish colour. After harvesting the ripe fruits are spread out on mats in the sun to dry. This causes them to blacken and to split open, when the seeds are easily extracted either by hand or by threshing or treading under foot. The dried husks of the fruit (valves of the dehisced capsule) are commonly used in China as fuel for the fires needed in extracting the " tallow ".

The removal of the tallow from the seeds is carried out with boiling water or steam, the remaining seeds being subsequently ground and pressed for the extraction of the kernel oil. Sometimes the seeds are crushed or ground before steaming and no attempt is made to keep the tallow and the kernel oil separate. This yields a mixed product of very much reduced commercial value. Consequently three distinct oleaginous products are prepared from the seeds viz.—(1) the fluid kernel oil (" tse-ieou "), (2) the solid pericarp fat or " wax " (" pi-ieou ") and (3) a mixture of (1) and (2) known as " mou-ieou " (4).

In India experiments have been made in preparing fat from the seeds of locally grown trees. The earlier experiments (7) do not appear to have been very encouraging, the fat being of a soft consistency, too soft for use by itself for candles in India. This may have been due to admixture with kernel oil resulting from crushing the seeds. As a result of later work, however, Puran Singh formed the opinion that its value as a tallow and oil yielding plant had been somewhat underrated in India in the past and that " the tallow and oil should be extracted by the aid of a solvent

extraction plant and not by bruising the seeds and steaming them as in China, since the yield of tallow by the latter process is at least 50 per cent. less than by the former " (10).

The vegetable tallow is employed in China as a substitute for animal tallow and may be used for candles and tapers or to a less extent for soap-making and in dressing cloth. These candles are pure white in colour and appear to retain their whiteness for any length of time. Samples of the prepared " wax " candles and seeds which have been in one of the Kew museums for well over half a century show no signs of losing their characteristic white colour. In candle-making in China the fat or " wax " is said to be commonly mixed with white insect wax in the proportion of three parts of the insect wax to ten parts of vegetable tallow. The candles are reputed to burn with a clear flame without smell or smoke and to be used especially in Buddhist ceremonies (7). Although of a wax-like consistency, the " tallow " is chemically a fat and not a wax.

In China the tallow may be separated from the seeds in various ways which have been described as follows :—" The consistence of the fat depends very much upon the method of preparation and the condition of the seeds operated upon. Dr. Porter Smith thus describes the process employed for obtaining the tallow from these seeds in China. The ripe nuts collected in mid-winter are bruised, and the pericarp or shell separated by sifting. They are then steamed in wooden cylinders with numerous holes at the bottom which fit upon kettles or boilers. The tallow is softened by this process, and is separated from the albumen of the seeds by gently beating them with stone mallets, when the tallow is effectually removed by sifting the mass through hot sieves. The tallow still contains the brown testa of the seeds, which is separated by pouring it into a cylinder made up of straw rings laid one on top of the other, in which it is put into a rude press, and the tallow is squeezed through in a pure state. A picul (= 133⅓ lbs.) of seeds yields from 20 to 30 catties of tallow, or about eight per cent., besides the oil which is obtained from the albumen by grinding, steaming and pressing it subsequently. This fatty substance is of a whitish colour, hard and tasteless, and melts at 104°F. (40°C.).

The second is a more simple method adopted in some parts of China where the shells with the coating of tallow and the kernels are bruised in a stone mortar, and the mass is boiled for some time in water, or steam allowed to pass into it. The fat is thus brought to the surface where it floats and is removed as a cake when the water beneath has cooled to the ordinary temperature of the atmosphere.

A third method is to extract the pulverised seeds together with their shells with petroleum ether or other solvent. This method is often used in the laboratory and yields a product similar to that prepared by the second method, consisting of the tallow from the outer layer mixed with the thinner oil from the endosperm of the seed." (7).

The residual press-cake is said to be unsuitable as a feeding stuff for livestock owing to the presence of saponin and also to possess a relatively low manurial value. In China the press-cake is used as fuel (1).

At one time quite large quantities of the " tallow " were imported into the United Kingdom and used mainly in the manufacture of candles, also

for soap and to a less extent as a means of stiffening softer edible fats. Hangkow was the main centre from which it was despatched. It was commonly imported from China in hard white cakes weighing about 1 cwt., the exterior of some blocks being a reddish colour with the inside a dull white (7). More recently the opinion has been expressed that the tallow may have possibilities in the cosmetics industry.

The kernel oil is prepared by crushing and pressing the seed residues left from the rendering of the " tallow ". In China this oil was at one time much used as an illuminant, also in preparing varnishes for umbrellas. The oil, which possesses a strong smell, has emetic properties and acts as a purge. Consignments of the oil appeared in European markets, though rarely, prior to 1930.

An analysis of seeds of *Sapium sebiferum* sent from Kew to the Imperial Institute in 1930, is given in the Bullutin of the Imperial Institute (1), also a summary of the findings of earlier investigators. The results of an examination of a fairly recent sample of the oil from China, a composite sample from a lot of 106 drums stored at the shippers' *go-down*, has been given as follows :—*

	Min.	*Max.*
Specific Gravity (15·5°C.)	0·9395	0·9458
Refractive Index (25°C.)	1·4810	1·4835
Iodine Number (Wij)	146·	160·
Saponification Number	205·	215·
Unsaponifiable Matter	—	1%
Acid Number	—	8
Acid Value	—	1·34
Free Fatty Acid	—	4%
Moisture and Impurity	—	5%

These figures agree fundamentally with those obtained by earlier investigators.

It is stated that when Stillingia oil (i.e. the kernel oil) is heated the colour gets paler until the temperature reaches 200°F. but darkens between 200/300°F. and cannot be brought back, also that this limits its use for " cooked " oils and varnishes as it tends to " throw " heavily from varnish on standing. When boiled the viscosity increases but is brought down with a volatile solvent and the oil may then be used as a paint medium. Care needs to be taken to keep the oil out of light as it bleaches rapidly and does not clear quickly on tanking.

The use of Stillingia oil in the paint and allied trades during the acute post-war shortage of drying oils has been considerably restricted by the price factor, for it has been a good deal more expensive than linseed, tung or Brazilian oiticica oil (*Licania rigida* Benth.). The high price naturally increases the price of the finished product and makes it difficult for the manufacturer to compete in world markets.

In considering the question as to whether *Sapium sebiferum* could be exploited in the sterling area as a source of drying oil, and indirectly of the vegetable tallow, there are many factors to be considered but on balance

*Figures and information kindly supplied by the Society of British Paint Manufacturers.

it would seem that the prospects are not very promising. There is no doubt that the establishment of the tree in plantation form in many parts of the sub-tropics and higher elevations of the tropics could be effected without difficulty. The tree is easily established (from seed, suckers, or cuttings), grows rapidly and commences to yield at an early age—for a tree crop. It appears to thrive under a wide range of climatic and soil conditions and does not seem to be unduly subject to pests or disease.

What has so far appeared to be the most serious obstacle in exploiting the tree for its " tallow " or its kernel oil has been the labour involved in collecting the ripe or ripening fruits, which have to be gathered by hand. In China the tree is said to be exploited only in areas where it is fairly abundant. Furthermore the kernel oil may only be prepared when the price likely to be obtained for it is considered sufficiently attractive. In Indo-China no attempt is made to utilize the seeds for tallow or kernel oil, which is significant. In the southern United States where some preliminary experiments in preparing the tallow and kernel oil from locally grown trees have recently been made it was found that harvesting by hand worked out at " around 5 cents a pound of nuts or approximately $100 a ton—prohibitive for any commercial undertaking ". (Public Ledger Oct. 5, 1947). Some may consider the labour in collecting the fruits is probably no greater than in olive picking and in the picking of berry and other fruits. This may be so, but whether an undertaking of this kind is worth while must depend on the value per unit weight of the product obtained.

With the increasing interest that is now being taken in tree crops, or potential tree crops, as against annual or tillage crops, in areas where soil erosion is severe the Chinese tallow tree may perhaps be worth bearing in mind. As already stated the tree has been found useful for fixing the sides of ravines and banks of rivers in India (10). It may well prove equally useful in controlling soil erosion elsewhere. In areas where agriculture is preponderantly in the hands of peasant cultivators the establishing of a few trees around homesteads or the margins of fields, yielding crops of fruits to be harvested by the cultivator and his family, may have possibilities, provided the harvesting time does not coincide with what may be a busy time with other crops and some sort of central organisation with proper equipment for processing the seeds is feasible.

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